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Bicycle Tools—III.

The Indiana Novelty Mfg. Co., of Plymouth, Indiana, which was engaged in the manufacture of a general line of small wood specialties, principally folding tables, Spalding's lawn tennis racquet frames, and other bent work, began the manufacture of bicycle wood wheel rims by the invention of Geo. W. Marble, superintendent, of the joint now used in their one-piece rims, in 1893.

The first rims of their make were sold in January, 1894. During the year ending July 1, 1895, their production was over 700,000 rims. They are prepared to make a million and a half of rims during the current year ending July 1, 1896, and their present orders fully justify their belief that their capacity will be taxed to meet the call for wood rims before the close of the present season.

SHOP FOR MAKING WOOD RIMS.—FIG. 10.

This company also make wooden mud guards, and their various processes of manufacture, except the single step of bending the wheel rims, are given in the following descriptions and illustrations. In regard to their method of wood bending, it can be safely said that it involves nothing new and that it is not more expeditious than the method followed at the St. Nicholas shops, which alone will be given at this time. There is, so far as at present known, but one good way to bend wood. That way, in general terms, consists of, first, steaming the wood to be bent until it is soft. Next, a flexible metal band is applied to the side of the wood which is to form the outer longer side of the finished piece, and end abutments secured to the flexible metal band are so adjusted that the wood strip or scantling to be bent touches these abutments at each end so that the outside of the curve cannot stretch in bending, and hence of necessity the inner or short side of the curve must be made shorter by the process of bending. This can be done without loss of strength. The structure of wood may be said to be a bundle of hollow round fibers, which have no very great tensile strength, but under a crushing strain break up and telescope into themselves, and thus constantly offer increasing resistances as the crushing strain is augmented. Hence the ability of a wood wheel rim to resist the strains due to a load borne by suspensory spokes is increased by crushing or shortening the inner side of the wood which is bent to form the wheel rim, while the outer metallic band prevents any loss of strength though stretching the outer surface of the rim. The metal band also prevents the slivering of a cross-grained piece of wood to some extent. This perfectly suitable method of bending wood cycle rims by the use of the end abutment carrying metallic band is used by all manufacturers of wood rims so far seen. Their methods are nearly identical and the cost of bending varies only within narrow limits in the various shops examined; yet each shop has had its own difficulties to overcome, and, except at the St. Nicholas, no shops were willing that their precise machines for rim bending should be shown. The present shops of the Indiana Co. consist of a main structure running east and west 290 feet by 60 feet, with a front south L forming the finishing room 150x60, and a second south wing 130x65, containing the dry kiln 96x65 and the machine shop; a 40 horse-power dry kiln engine, with blower and apparatus and a dynamo taking the remainder of the second south wing. Between the finishing room and the dry kiln, and opening out of the finishing room, is the packing room, 85x32, two stories high, extending near enough to the Pittsburg & Ft. Wayne side track to permit loading directly on to cars. There is also another side track used for incoming materials. The two side tracks will hold twenty-five cars. Between the dry kiln and the main building is the bending room, 160x40; this room has, near its middle, a double-ended brick steam box, with large wooden hoods and steam chimneys covering the overhead space in front of each end of the steam box, and the twelve bending machines in use are conveniently located around the steam box. The company is at present actively engaged in doubling its rim bending capacity. At the extreme easterly end of the main building is a south wing 40x60, containing the boilers and main engine, 200 horse-power Corliss. A north wing, 135x82 feet at the east end of the main building, contains a large number of circular and band saws, planing, sticking and shaping machines for preparing the stock for wood rims and mud guards. Except the office and the shipping room all of these buildings are of one story only, and all are built of brick with three-ply asbestos roofing, framed skylights and ventilators, the entire plant of the company representing a cash expenditure of nearly $200,000.

All of these large and well-lighted rooms are filled with excellent machines, almost wholly, with the exception of that in the north wing, built from designs by Mr. Marble, and of that in the north wing much has been so specialized by him as to be adapted to purposes never contemplated by the original builder. Even the varnishing and packing rooms, where no power is used, are filled with special devices and appliances for expediting the various operations there carried on, and the whole place is steam-heated, electric-lighted, and will soon be, also, power-ventilated throughout; as a complete system of dust collectors, exhaust pipes and furnace feeders is now being placed, the whole establishment may be

Fig. 11.

Fig. 12.

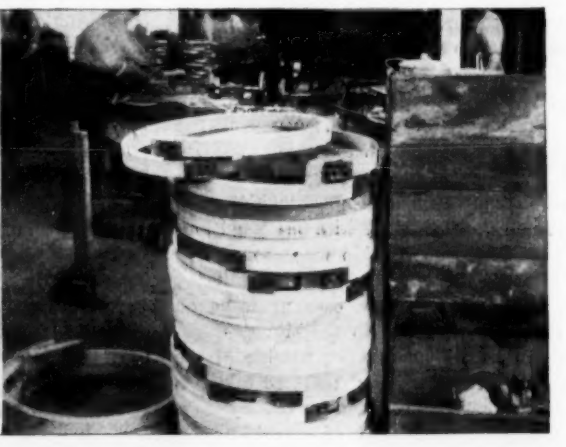


Fig. 13.

BICYCLE WOOD RIM MAKING.

classed as fully up to the very best modern woodworking practice. Numerous agencies here and abroad help in marketing these rims, but, owing to the peculiarities of foreign pneumatic tires not being adapted to the use of wood rims, the advance of the wood rim in Europe was at first slow; now, however, there is a marked disposition on the part of the foreign cycle makers to modify their tires to suit wooden rims, and it is confidently expected that the wooden rim will quickly reach in foreign countries

the vogue it now has in America. Of course numerous patents granted to various inventors are controlled by the company, some of these being upon features of the rim itself, others upon processes and machines used in manufacturing. We cannot undertake to specify them in each case.

The stock used by the Novelty Co. is rock elm exclusively, great care being used in the selection, first, of localities from which the stock is obtainable, and next in the inspection of each individual piece as it is unloaded from the cars preparatory to piling for natural open-air seasoning, as shown in Fig. 11. The pieces stand in the pile for about 90 days, and are then considered sufficiently seasoned for use: this exposure to open air gives, as is well known, a hardness and toughness to timber which cannot be attained by any artificial quick process.

In the factory the strips go first to the large steam box shown in Fig. 12. This is a brick structure, piped with steam in the usual manner, long enough to take in two lengths of the strips, and having two sets of doors at each end so that if needful four workmen can take strips from the box at the same time. A large overhead wooden hood, tapering up to a flue passing through the roof into the open air, serves to catch and carry away the steam which escapes when the steam box door is opened. From the steam box the strips are taken one at a time to the bending machines, where they are bent and have their ends clamped to an inside temporary clamping block, by which they are held as shown in the pile of bent rims, Fig. 13. In this form the wet rims are ready for the dry kiln. Fig. 14 shows the dry kiln air circulating fan (by the Buffalo Forge Co.). The circulation is continuous, the air drawn from the dry kiln being forced through the stack of live steam pipes back into the kiln again, means being provided to establish a uniform current of hot air through all parts of the dry kiln itself, one corner of which is shown at the right of Fig. 14. One whole side of the dry kiln next to the rim-bending room is composed of counterbalanced doors which open by sliding upwards; the kiln has partitions every 16 feet, and the doors are something less than 16 feet wide; to enter the kiln the rims are stacked up on cars mounted on small wheels to roll into the kiln compartments; these kiln cars when outside of the kiln stand on a wheeled traverse table, so that a loaded kiln car can be readily traversed the whole length of the kiln, the traverse truck having crosswise tracks on top to accommodate the wheels of the kiln cars, these car wheel tracks matching the tracks in the interior of the kiln when a kiln door is opened.

Fig. 15 shows a kiln car in process of loading, the bent rims being wheeled directly on the top of the car on barrows, as shown, the track for the traverse truck being sunk so as to bring the top of the kiln cars flush with the main floor of the shops.

When a car is filled a kiln door is opened, and the car, of a width and hight when loaded to correspond to the cross-section of the kiln compartment, is quickly rolled into place inside, and the kiln door closed again The capacity of the dry kiln is 45,000 rims, and the time required for the kiln drying of the rims is about 30 hours. This would give an extreme drying capacity of about 10,000,000 rims per year, if the kiln were worked continuously.

From the dry kiln the rims go first to the measurer, who measures the inner circumference of the rim with such a hand wheel as a carriage smith uses for measuring tires, as shown in Fig 16. The wheel rim is laid on a table with the joint next to the workman, who presses the rim with his body against two pins in the table, and first makes a pencil mark on the inside of the left hand end of the rim, where the wood is sound and fit for the joint; next the first index line on measuring wheel is brought to this pencil mark, and the wheel is then run quickly around the inside of the rim and a pencil mark is made on the inside of the right-hand end from the second index line on the measuring wheel, the location of this second index line of course varying with the diameter of the rim to be produced.

Hugh Dolnar.

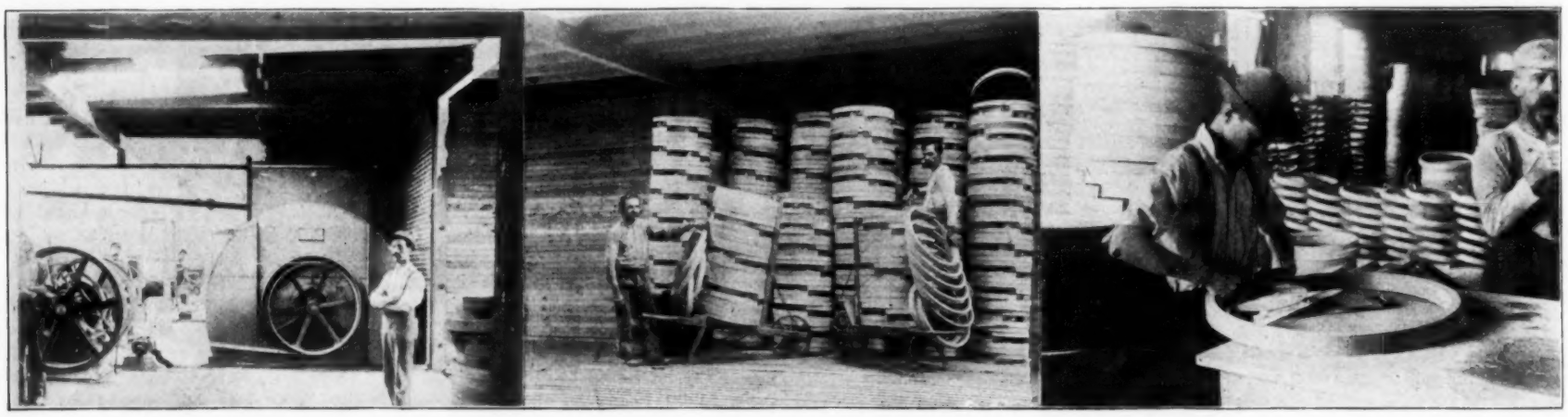


Fig. 14. *Fig. 15.* *Fig. 16.*

Making Bicycle Wood Rims.

Cylinder Oils and Oil Experts.

By W. E. Crane.

One thing that engineers have to contend with is cylinder oil and its advocates.

It is possible that a few reminiscences on this subject may not be uninteresting.

Thirty years ago the use of tallow for lubricating cylinders and valves was universal.

The objections to tallow were, first, the animal acid it contains, which, when subjected to heat, becomes disengaged and corrodes the iron, so that with a knife the black lead can be scraped off, and bolts, nuts, plates, steel springs, and everything coming in contact with it, will be ruined. Have seen a cylinder head that was made of porous iron honeycombed so thoroughly as to necessitate putting on a new head. The second objection was the sediment deposited in the form of balls and the like, which in some cases with long ports would stop them up so that full speed could not be maintained at all times. Another reason is the difficulty of feeding regularly. Aside from these objections, tallow is the best lubricant for hot surfaces that has ever been used.

To overcome the objections, neatsfoot oil was tried, but this was found to have been refined by the acid process, and was but little better than tallow, so far as corrosion went, while it was much more expensive. At about this time a Corliss engine was put in. This, by the way, was in a rolling mill. Now rolling mill work is very irregular, and the engine would be running for a long time cutting off so short that the valves would not open sufficiently to get oil under them, and they had to depend on the oil that was there when there was a heavy load. Someone had discovered that sperm oil was not troubled with acid, and this oil was used with good success, except that the valves, springs, and packing had to be taken out and cleaned from gum once in from four to six weeks.

About the year 1873 it was found that petroleum would lubricate an ordinary cylinder, that it was free from acid and gum, and an excellent thing all around, and also had the advantage of being cheaper, although then sold for $1.25 per gallon. This oil, however, was found, after it had cleaned out all the sperm oil, to not have sufficient body to stand up under the duty of oiling the valves, so that they would close of themselves when the load was light. About 30 per cent. of sperm was added to it, and it worked as well as the sperm alone, and there was no gumming from it.

After a time another manufacturer came around with an oil compounded from petroleum and animal oil. This was made from proportions, materials, and in a manner that left nothing to be desired, oiling everything nicely, and leaving no bad results behind.

After this numerous oils were tried with varying results, but no oil not compounded would operate under the conditions named. Such oils were always mixed with some animal oil, and it was found that adding about 10 per cent. of tallow would add materially to their durability.

When there is no more than 30 per cent. of animal oil mixed with petroleum it will stand 5 to 10 per cent. of tallow without injury, but when a deposit is found in any part of the steam passages, then too much has been used, and when any compounded oil shows anything of the kind, it shows that it is unsafe and unwise to use it.

At the present price of good cylinder oil it will not pay anyone to make it up themselves, unless they get caught with some uncompounded petroleum on their hands, when they can mix sperm, lard, or neatsfoot oil with it, with not to exceed 10 per cent. of tallow.

Occasionally we find, even at the present time, men selling oil who make a strong claim that theirs is clear petroleum. A few years ago one of this class wanted to put oil of this character in on its merits, and after it was tried and found wanting he succeeded in getting an expert to pronounce the oil all right, but that did not sell the oil. After a year he came around again with what he claimed was a nice compounded oil. When asked why he had changed his mind he answered that it was experience.

When asked what he had done with the professor that had made the experiments, he replied that his people had made up their minds that the professor knew nothing about oils; that their following the results of his experiments had cost their concern many thousands of dollars, lost them lots of custom, and they saw there was no use to make anything but a compounded oil.

Our railroads are doing a good deal of engaging of experts having no practical experience, and adopting oils that they recommend.

In course of conversation recently with an old engineer on a road having about 1,000 locomotives he related the experience they were having with oils. It seems that an oil merchant has undertaken to run the locomotives with a certain quantity of oil per day without regard to the type or size of engine. This company has some heavy machines with large wheels so that they stand well up in the air. These locomotives "ride hard," and when engineers have a chance they get off and oil the wedges. This does no good, and one man found that putting in a good amount of cylinder oil would alter the riding materially.

This is only with the large engines with large wheels, the same thing not being noticed with the smaller engines.

What the effect of imperfect lubrication has upon the coal and repair bill they are taking no measures to ascertain, but the saving in oil is a howling success, and if the valves want to howl no one hears them.

Cylinder oil should be made for the purpose for which it is to be used. It should vaporize, and an oil with a high fire test that would be right for high pressure and hot steam, would be worth little for low pressure.

Also, an oil of high viscosity that would be all right for heavy pistons and high unbalanced pressure on valves would be entirely unsuitable for light work.

In some cases low viscosity and high fire test is wanted, in others just the reverse.

A heavy low-pressure piston would want high viscosity and low fire test, while if the high-pressure piston was heavy it would want high viscosity and high fire test, and these varying needs can only be met by manufacturers who thoroughly understand the nature of oils and their proper mixture.

A high-price oil is not necessarily a first-class oil, nor can an improper oil be afforded, no matter how cheap it may be, for if the lubrication is not all right, the expense for coal and repairs will cost many times the saving in oil.

Waterbury, Conn.

Steel Thoroughly Annealed.

The *Indian Textile Journal*, published at Bombay, India, reproduces with commendation our article of July 4th, upon "Annealing Steel," and in connection with it contributes the following interesting item:

Many workmen in metal have never seen a piece of steel made as soft as possible by annealing; it probably happens only by accident. When Alexandria was burnt in 1882, many houses that were fired in the lower stories fell, and afterward smoldered for weeks before cooling down. The mixture of wood and stone in the floors and walls favored this slow combustion. One of the houses contained a very well-appointed dentist's workshop and operating room, which lay for seven weeks in the wreck of wood and masonry until reached by the labor gangs. The dentist's files were found to be so soft that some that were half an inch wide could be bent almost like lead. After several bends they began to crystallize and become stiffer. From their appearance they had been red hot, heated by the surrounding material, probably burning furniture—and then cooled, in the manner best calculated, according to the American Machinist, to produce the greatest possible softness. The fractured end of a test bar of steel cooled in this way would doubtless show a surface peculiar to the process of cooling.

It is said that Mr. Geo. Westinghouse has invented a gas engine that saves 50 per cent. of the expense of generating power as compared with the steam engine.

Simonds' Electrical Pyrometer.

The article by Mr. A. A. Simonds on "Scientific Tempering," which we published in our issue of September 19th, has attracted a great deal of attention, and we are

SIMONDS' PYROMETER.

certain our readers will be interested in the pyrometer by which he measures the temperature of his furnaces. We therefore present herewith an engraving of it. At *A* are two small wires which project slightly from a ½-inch tube. One of these wires is platinum and the other an alloy of platinum. They connect with copper wires which pass on through the tube, and are seen at *H H* where they are connected with a galvanometer.

The ½-inch tube through which the wires pass is encased in a 1¼-inch pipe, which serves as a water jacket, water entering by the tube *E* through which it passes to a point near the other end and is discharged into the jacket through which it then circulates to the outlet *D*. Thus only the short platinum wires are heated, the rest of the instrument being cool.

The galvanic current generated by the heated wires passes through the copper wires to the galvanometer, and thus indicates the temperature, and it is found that so long as the current of water is maintained any temperature below the melting point of platinum (over 3,000° F.) will be continuously indicated and can be accurately observed.

Since in accurate work the temperature of the room must be taken into consideration, a simple table is prepared by which galvanometer readings can be readily corrected.

The pipe *C* is inserted in the furnace so that the wires enter the heated chamber, and the only requirements are a 1¼-inch hole through into the furnace and a small constant stream of water.

The instrument is ordinarily made about four feet long, but can be made longer or shorter to suit conditions, and is found to be easily managed by men who have hardening to do.

This instrument is manufactured by A. A. Simonds & Son, Dayton, Ohio.

Vertical Turning and Boring Machines.

We present herewith engravings of a 30-inch and of a 40 inch vertical turning and boring machines, and give also a sectional view showing the construction of the table, its bearings, and the method of driving it.

The smaller machine is the simplest form of the tool and is intended for doing a class of work usually done upon lathe face plates, but has the advantage of the lathe, especially in points of convenience in setting work, and in rigidity and driving power.

The essential features of both machines will be apparent at a glance. Referring to the 30-inch machine, its table is 28 inches diameter, and can be driven at eight speeds, ranging from 1⅞ to 43 revolutions per minute. The ratio of gearing is 35 to 1, and the table is driven by a wrought-iron pinion on a vertical shaft, this pinion engaging the gear on the table at a point directly under the tool when cutting at the maximum diameter.

The feeds—horizontal and vertical—are derived from friction gearing, and are variable from 0 to ¼ inch, quickly and without stopping.

Two tool posts are provided for more securely holding long tools, especially when boring.

The frame is designed to resist the stress of heavy cutting, and there is an annular ring-bearing near its outer edge to more fully support it. Tool steel 1½ inches square can be used in the tool posts shown, and special holders can, of course, be supplied.

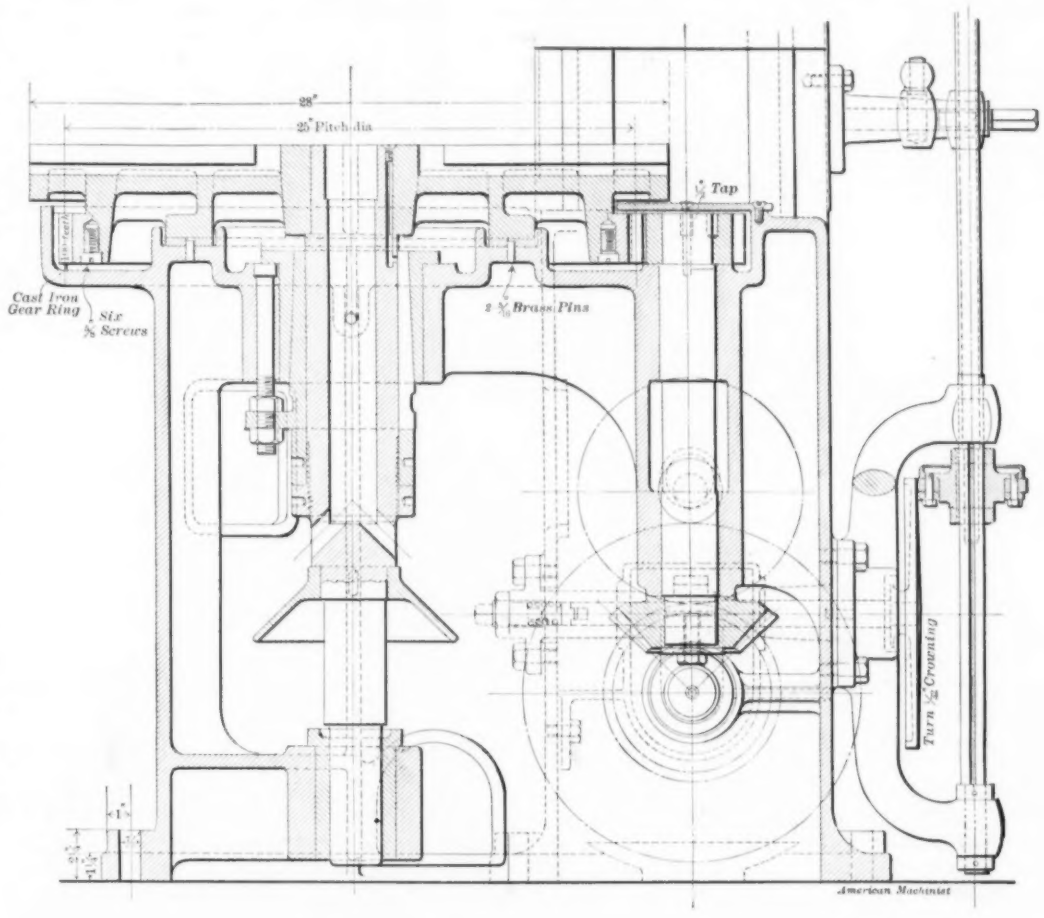
The machine is also made with a revolving turret for holding tools.

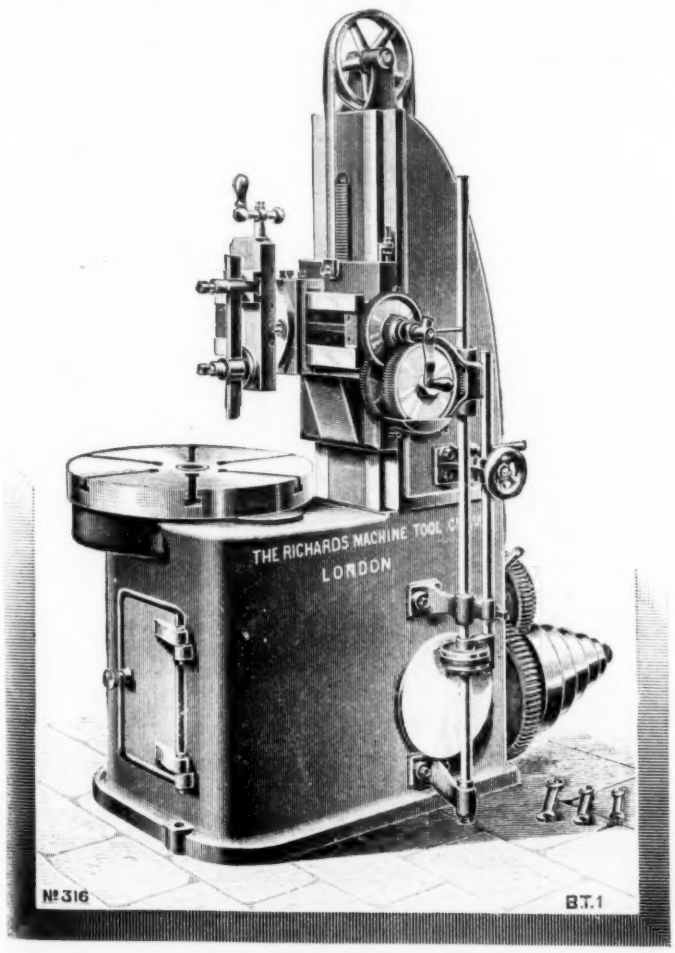
The vertical feed of slide on column is 18½ inches; horizontal feed 16 inches. A machine of the same nominal capacity and general design is made with a regular boring-mill style of bar (octagonal section), the bar in this case being fed vertically or at any angle. The arrangement is similar to that shown in the case of the 40 inch machine which we also illustrate. In both machines the counterbalancing is done by a weight which is inside of the upright.

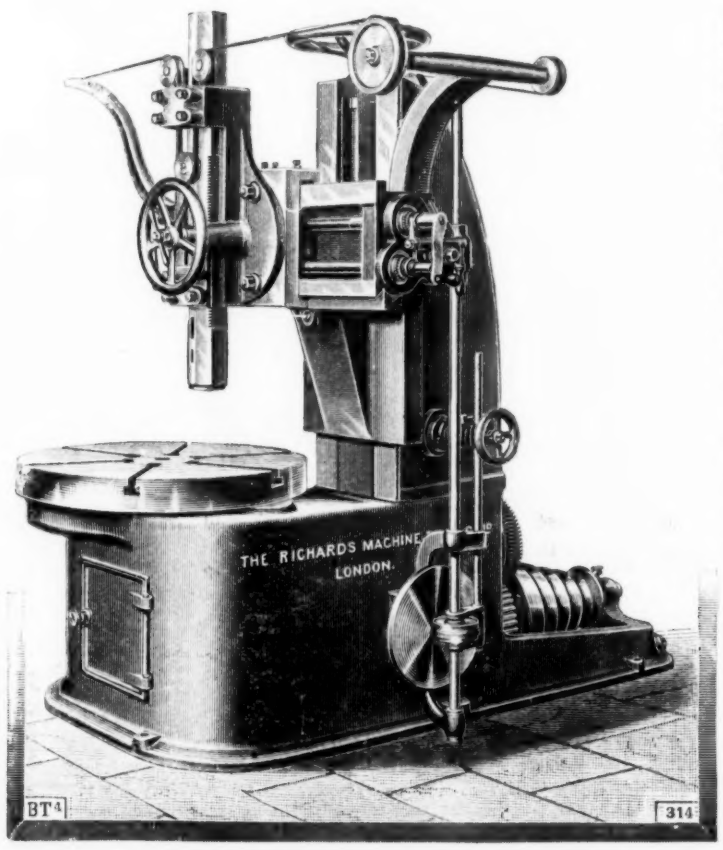
In this 40-inch machine the ratio of gearing is 45 to 1; the cone has five steps for a 3½-inch belt, and the table speeds range from 1 to 50 revolutions per minute.

The saddle and cross rail are raised and lowered by power, and the boring bar has a feed of 19 inches. All gearing on these machines is machine cut.

They are built by The Richards Machine Tool Co., Suffolk House, Laurence Pountney Hill, E. C., London, England.







VERTICAL TURNING AND BORING MACHINE.

Mica cartridges are the latest invention for lubricating the gun barrel and protecting it from corrosion.

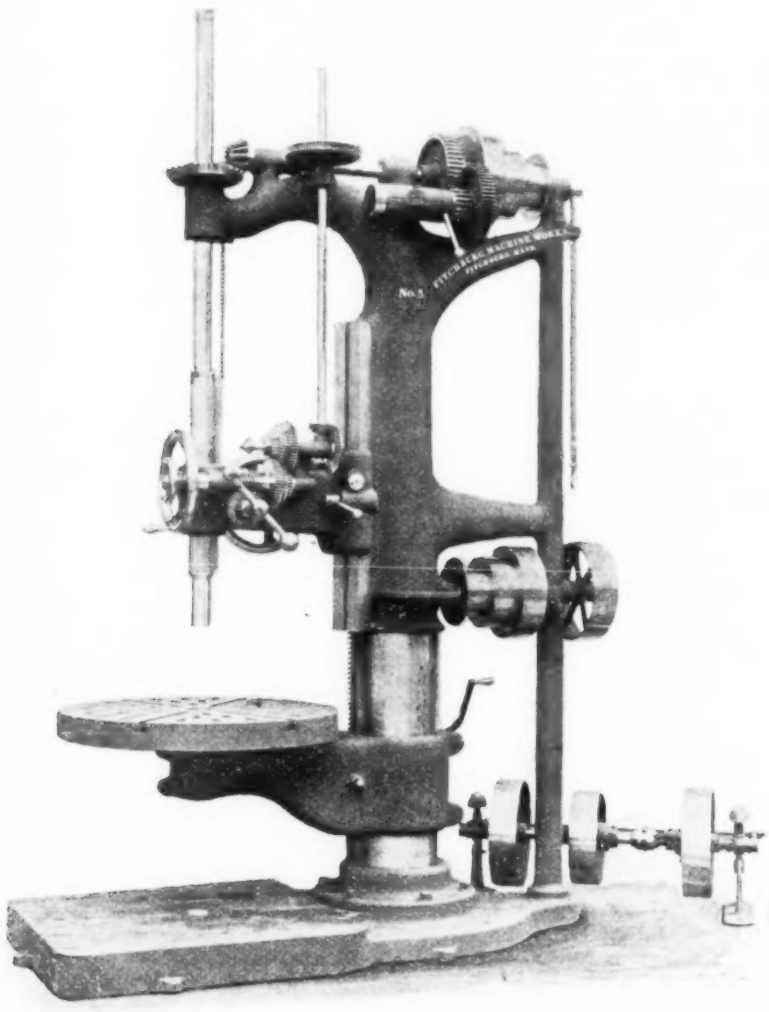
Lubricating the Edge of a Cutting Tool.

We cannot help thinking that a recent writer upon the uses of compressed air in *Cassier's Magazine* has allowed his zeal in a good cause to carry him a little too far. The following paragraph we find has been seized with avidity by our enterprising contemporaries, and seems likely to be widely circulated:

Use of Air Jets in Lathe Work.—In turning soft steel shafting, it is customary to use water to which a certain percentage of sal-soda has been added, in order that the water may not rust the finished work, and with a keen tool of the proper temper, and wide enough cutting edge to cover the feed, a very smooth and shining surface can be produced. By using a small air jet, that is, air issuing from an orifice of about one-sixteenth inch in diameter, the work can be finished very much the same as if water was used. A smooth surface will be produced with this important difference, that the tool will not crowd, and consequently the shaft will be nearer true and straight when using a compressed air jet than when using water.

Every machinist is familiar with the "water cut" for wrought iron or soft steel. When a liquid is used upon a lathe or planer tool in cutting these metals, the power required seems to be reduced, while the condition and appearance of the surface cut is greatly changed. When we used to be operating an engine lathe we thought that with a nicely oil-stoned side tool cutting a piece of clean, soft wrought-iron, and with a plenty of clean water falling upon it, we could produce the most beautiful metallic surface that mortal eyes ever beheld. Possibly we rated the beauty and perfection of the work a little too highly, but still it is certain that very remarkable results accompany the use of water upon steel or wrought-iron as compared with the dry cutting of the same material. The use of clean water is objectionable, simply on account of the readiness with which everything rusts after being wet, and so it has become the custom to avoid the use of pure water as much as possible. Soapy water is frequently used, and soda water quite generally, and last, because most expensive, oil is used with cutting tools, and better results are secured with their use than could possibly be found

with cutting the metals dry, while some operations would be impossible without the lubricant. The effect of the liquid upon the cutting tool and the metal is twofold, or perhaps it would be more correct to say threefold. The first and principal effect is



Large Drill Press.

that of a lubricant pure and simple. It lubricates the sides of the wedge. The cutting tool acts as any other wedge, and the ultimate severing of the metal, no matter how fine may be the edge, is a tearing of the material. Take the finest surface that has been produced in the lathe with a water cut and pass the bare hand over it in the same direction in which the cutting tool has traversed the surface, and a certain roughness will be perceived that will not be felt if the hand is passed over the surface in the opposite direction. It is as if the surface were like that of a rasp, the teeth all standing in one direction, or facing in opposition to the tool, they having been partially raised or torn out of the bed of metal and broken off by the wedge action that separated the chip from the body of solid metal. The second effect of the liquid is the consequence of the first, or the effect of the lubrication. The lubrication of the wedge prevents the heating of the tool in proportion as it reduces the friction. It does not appear that either of these two effects are accomplished by the air jet. We have little hesitation in saying that we do not believe that lubrication and the consequence of that lubrication, as just mentioned, are accomplished by the air jet. We do not believe until we see it, that the familiar bright and highly polished surface that is left by the tool with the water cut is also exhibited by the surface cut by the tool that is "lubricated" by a jet of dry air. The third effect of the liquid flowing upon the cutting tool, the actual cooling of the tool, we have no doubt is also accomplished to a considerable extent by the air jet. If the air is carried at a pressure such as is commonly used for hoists and motors, say, six atmospheres, and suddenly discharged into the atmosphere, it must be quite cool, and must have a decidedly cooling effect upon the tool that it strikes. We cannot say how close to the actual cutting edge of the tool the cold air may penetrate, but we should judge that it could not penetrate as far into the work, and as close to the seat of the actual cutting operation as the liquid would penetrate. When the liquid falls upon the work and upon the cutting tool it, of course, does not fall upon the cutting edge of the tool, for that is buried in the metal, but it is carried forward very close to the actual, ultimate cutting edge by capillary attraction. We do not know how much the air may be drawn in the same way by capillary attraction, but it is highly improbable that the air penetrates as close to the actual location of the cutting operation as the liquid does, and the completeness of this penetration is an important point. There is a difference in the capillary penetration of the different liquids, which is a reason why pure water has such an excellent effect. It is probable that pure water gets nearer to the actual point where the metals are severed, and where the friction against the sides of the tool begins, than any of the thicker and more viscous liquids can penetrate, and it is also in a better mood for absorbing and carrying off the heat from the metal. Even for the purpose of cooling the tool, so that its temper will not be affected, and that it may last as long as possible, it would seem that the liquid must be more effective than the air. It is to be remembered in this connection that to maintain a jet one-sixteenth inch in diameter of air at six atmospheres will require nearly one horse-power, while the water will cost practically nothing, and soda water very little. But that is of little importance if any good is accomplished.

There are many curious phenomena connected with the lubrication of cutting tools by the use of liquids, and the subject will admit of, or we might say, demands much more investigation than it has yet received, and it promises to reward the investigator with results of considerable practical value and importance. Even where a tool stands well, and does not seem to heat up much, it is probable that the extreme edge does get quite hot, only that the heat is rapidly carried away by the metal behind the apex. Evidence of this seems to be exhibited in the fact that the petroleum oils are so unfit for this service while the animal oils are always to be relied upon. The mineral oils are volatilized by the heat and the tool cuts dry, while the animal oils are not affected and do their expected duty. One other point that is alluded to in the paragraph quoted above is of considerable importance, and we have not the least doubt of its truth. It is said that "the tool will not crowd." That is, the tool cutting dry with the air jet will not crowd away from the cut, or will not require as much pressure to hold it to the cut, as would be required with a lubricating liquid. When the tool or wedge is in the cut, and slipping more easily on account of the lubricant, it feels more readily the difference in the pressures upon its two sides, the yielding pressure upon the chip side and the unyielding pressure upon the solid side, and it is more ready to go to the chip side and away from the solid side than if it were not so well lubricated, and it therefore requires more pressure to hold it against the work, or, if the work is springy, to hold the work to it. This is shown especially in cutting hard steel, where it is almost impossible to use a lubricant for the tool on account of the difficulty of maintaining a sufficient pressure of the tool against the work in addition to the cutting power required, especially if the chip is a thin one.

The whole subject of lubrication has been neglected until very recently. Too many mechanics have regarded oil, even upon a steam engine, as a convenient and necessary expedient for stopping squeaking and wear, and for making it possible to keep running, instead of regarding it from the first as an essential part of the apparatus, almost as much as a connecting rod is a part of it. The oiling devices upon most machinery appear to be an afterthought, and have a more or less temporizing air about them, instead of appearing to be as they are and should be—elements of the original design, and thought of and planned for from the very beginning. So the study of lubricants and lubricating devices has come late, but it has already done much for the successful operation of modern machinery. There has been no systematic investigation within our knowledge of this whole matter of the lubrication of cutting tools, at least in any way commensurate with the importance of the subject and the promise of advantage to be found in it.

We do not use the water cut for cast-iron. The water will rust everything so terribly that we cannot think of that for a minute. It is too expensive an operation to use oil for cutting cast-iron because the oil would be absorbed by the chips so rapidly that none of it could be recovered, and even soda water would make a great mess if used upon cast-iron. Still we are decidedly of the opinion that the use of a lubricant for finishing cast-iron surfaces is well worthy of experiment and investigation, especially for surfaces that are to be used as wearing surfaces. With the lubricant there must certainly be less ultimate tearing of the metal and a closer surface must result—a very desirable condition for journals and similar uses.

A Large Drill Press.

We present herewith engravings of a drill press designed especially for boring two 8-inch holes simultaneously in steel bridge chords; the work, as we understand the matter, being so arranged that two cutters, or sets of cutters, are used upon the same bar. The machine is in use at the shops of the Berlin Iron Bridge Co., and weighs about 6,800 pounds.

Two friction pulleys are provided upon the countershaft, and there are three steps upon the cones, giving, with the back gears,

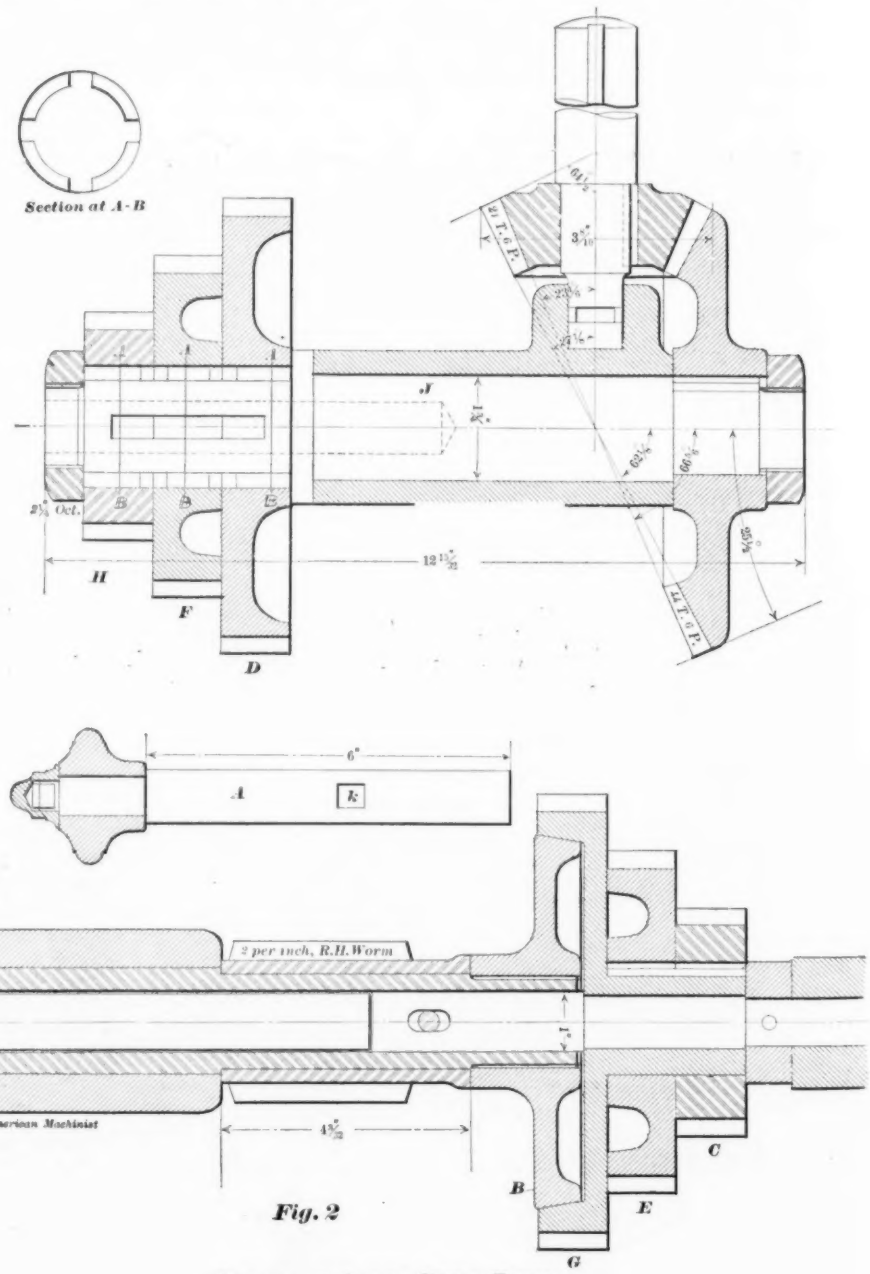


Fig. 2

Details of Large Drill Press.

twelve changes of speed, ranging from 6 to 250 revolutions per minute.

The table is 42 inches diameter, and the planed surface of the base plate is 42 inches

by 44 inches, provided with five T-slots. The table has a suitable hole for boring bar bushings, and the maximum distance from spindle to table is 36 inches, and to base plate 61 inches.

The construction of the feed mechanism will be understood from Fig. 2, where *A* is a push-and-pull pin sliding within the upper cone gear shaft *J*, and carrying a key *k*, which engages with either of the gear wheels *H*, *F*, or *D*, all of which ordinarily turn freely upon the shaft, and are in engagement with corresponding gears on the lower shaft, the rates of feed being 60, 126, and 261 revolutions per inch.

No two feed gears can be engaged at the same time, and changes can be made without stopping the machine.

A quick return for spindle is provided by means of balanced handle and crab clutch. The table has a vertical movement of 21 inches, and the spindle feeds 20 inches. The machine is built by the Fitchburg Machine Works, Fitchburg, Mass.

The Construction of the Teeth of Gear Patterns.

By Isaac Whitehead.

The article by Mr. Dingey, on miter gears, in your issue of August 22d, and the criticism by Mr. Swift, in the September 5th issue, raises a question of much importance to patternmakers, for under the present system of specialties most of them have not the opportunity of personal experience, and yet may be called upon to make a gear, and it is very desirable to know the result of the long experience of those who are most in it. If each patternmaker having special experience in certain foundation lines would write it up, it would greatly advance his craft and himself.

The question of the construction of teeth for gear patterns applies equally to bevel, miter, or spur gears, and I think among the shops who make a specialty in their manufacture there is not much variety of opinion as to the best method under general conditions.

To enable us to more clearly discuss the relative merits of the different ways, I have laid out the proportions of teeth and rim for 1½ inch pitch. No. 1 is Mr. Dingey's proposition, as I understand it; No. 2 is very near like it in principle, and was published by Jno. Walker with his gear chart patent in 1871; No. 3 is the principle of dovetailing as I have seen it in good practice, while No. 4 is the gluing and nailing on of the teeth, sometimes shaped before and sometimes after.

By No. 1 and 2 we gain a perfect hollow at the base of the tooth, but No. 1 forms a thin wing on each side, and a joint down the center between the teeth which is liable to curl open from the rim being thin and crossways to the grain. In my experience, a joint that is glued across the grain is never reliable because of the varying shrinkage, and would require nailing or screwing, which is undesirable. The forming of the wing would be tedious, and to avoid this and other objections No. 2 was evidently designed. To form No. 2, a series of flats are formed on the rim to match the width of a tooth and lag. The lag forms the flat between the teeth and is planed a slight taper, then glued and nailed on, thus forming a dovetail space for the tooth blocks, which are fitted in and driven tight enough so that they may be turned, faced up and laid off. Then they may be driven out separately and shaped, then replaced with glue and nails or screws. The designer of No. 2 found such practical objections to it that he did not apply it in his own works, but favored the dovetailing method No. 3. This method has the advantage of a dovetail, solid with the tooth, made by a simple device shown later. Being solid with the tooth, it will stand to be driven in tight into the slot, and as the grains of the wood in each layer in the rim cross each other to some extent, it makes the sides of the slot strong to withstand it. After the blocks have been fitted in, faced up and laid off they are driven out and shaped to form, and when finished are driven home to their place, requiring no other fastening but a touch of glue on a short space at one end of the tooth, so that the rim can shrink and swell without breaking the glued portion. Two or three of the

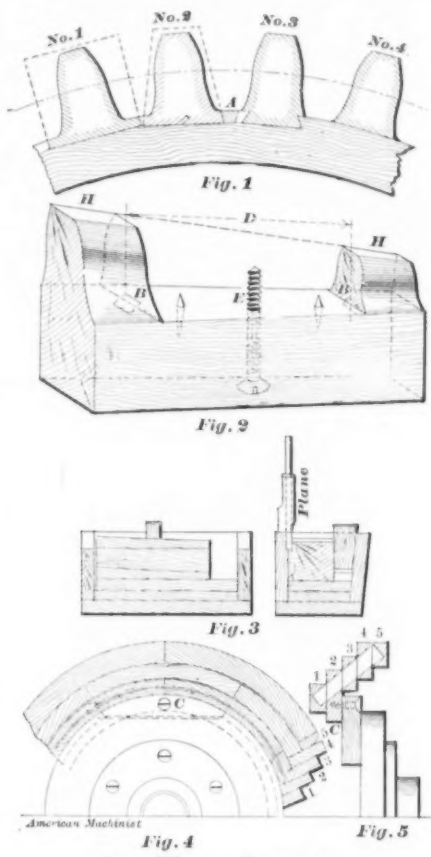


Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5.

Gear-Wheel Patterns.

teeth are left without glue and marked so that the molder can drive them out and use them in case he requires to mend up.

The objection to this method is the feather edge left in forming the hollow at the base of the tooth, but practically this is so small, as the whole of the hollow cannot be larger than the clearance at the depth of tooth, and the tooth being generally formed from a closer grained wood, most of the hollow can be formed upon it, while the rest of it is largely made by the three coats of varnish and the sandpapering necessary to finish the surface. The fourth method shown is sometimes used to advantage in the case of a rack or short segment of a gear, and by the use of a jig, as shown in Fig. 2, the teeth can be got out a uniform shape either straight or taper. The jig is readily made by laying out the form of tooth at each end of a block of hard wood, allowing a base to it as shown. The tooth block to be formed is just the length of the part *D* cut out, while the screw *E* is used to hold the block down while the spurs hold it in place. Sometimes the spurs are placed in the center at the ends at *B*, which will uniformly place a center mark by which the tooth can be fixed upon the center spacings on the wheel or body of pattern. The ends of the jig *H* should be long enough so that in working the hollow or rabbet plane it will not be allowed to pass over the ends, and the form will be kept perfect.

I have shown in Fig. 3 a device for planing out the dovetail solid with the tooth. It can be nailed together in a short time, and is adapted to any kind or size of tooth required; almost any old, antiquated round, or hollow, or bead plane can be altered to serve the purpose. Once set it will plane all the dovetails the same size and taper in relation to the block. I have sometimes fitted the dovetail pieces separately upon the blocks, facing them off level in the lathe, then nailed and glued them on the tooth blocks, which were hollowed out to fit the rim, but the dovetail was so thin that it would sometimes split or move on the block in driving them in place.

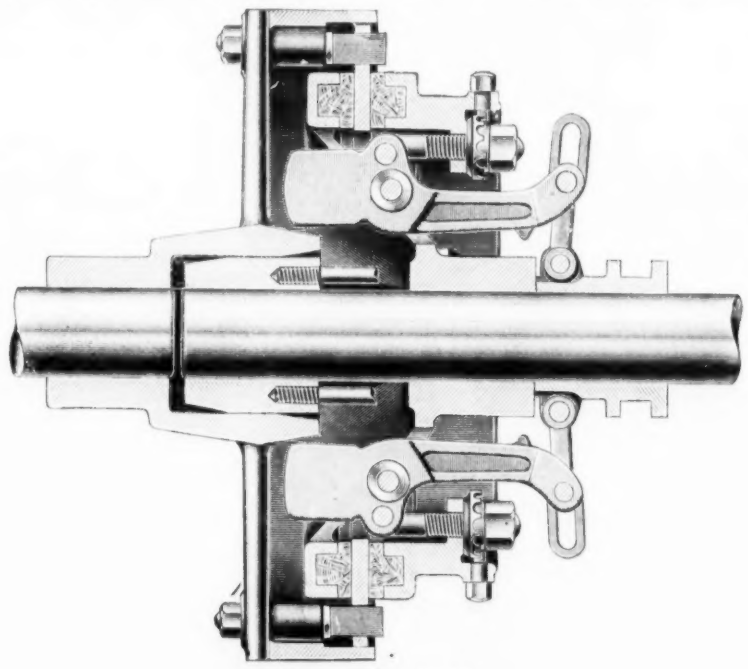
In connection with Mr. Dingey's paper, I would like to offer a suggestion on building up the rim which I have found to work well and save labor in practice. On one of the courses in building up miter or bevel gears, in this case I have shown it in the second, to leave three segments of the course straight on the inside, as shown at *c* in Fig. 4. In the case of eight segments take four, or, generally, take every other segment.

After the ring is built up it is taken off the face plate and screwed through these projections to it again as shown at *c* in Figs. 4 and 5. This contrivance enables it to be turned inside and out without re-chucking or turning it round on the face plate, which is a very great advantage to obtain accuracy. It is therefore turned down to size as shown in the section, Fig. 5, leaving only the necessary connection at *c*, and the inside of the rim can be made perfectly straight across by paring through the ridge between the connections, and testing it with a small straightedge. The rim can be taken off after boring two or three dowel holes through the connections, if desirable, while the teeth are fitted into the ring, then returned to the lathe, finding its place exactly by the dowel pins. To finish the rim and teeth of the wheel free from the arms and hub, I think, is rather an advantage also, as other wheel centers may be put in when desired.

A New Cut-Off Coupling.

The E. W. Bliss Company, of Brooklyn, N. Y., manufacturers of the Waldron flexible friction clutch pulleys, have adapted the principles of that clutch to a cut-off coupling, which would seem to be worthy of special notice. The clutch parts are the same as in the flexible friction clutch pulleys made by this company, and the coupling therefore possesses the same merits of flexibility, simplicity and compactness as the clutch pulleys. A special feature is the centering device, which will be understood by the accompanying sectional view.

Ordinary line shafting, especially when of small diameter, is liable to run slightly out of alignment. In consequence of this, if two shafts are coupled by a cut-off coupling, when the coupling is thrown out of engagement and one shaft allowed to revolve while the other remains at rest, the revolving shaft may not turn perfectly true with the other. If there is no bearing provided to prevent this and hold the two shafts in line when again coupled and revolving together,



Cut off Coupling.

the shaft as a whole will have an eccentric motion. On the other hand, where such a bearing is provided, when the shafts are uncoupled, the bearing may be rapidly worn away on account of the eccentric motion or position of the revolving shaft. To provide against these contingencies this coupling is made with the centering device shown. When thrown out the cone is withdrawn from the recess in the opposite member, allowing each shaft to take its natural position and revolve freely without any wearing surfaces. When the shifter is moved to throw the clutch into operation, before the friction rings grip the flexible plate, the cone brings the two shafts in alignment and insures the clutch and shafts revolving properly together.

Letters from Practical Men.

Trade Conceit—High Speeds.

Editor American Machinist:

If there is any one class of men who would frown upon caste pretentions more than another, we believe it to be machinists. However, we never could help thinking that there is an air about many of our brother "chips," which seems to say, "we are a little better than your molders or your blacksmiths," yet, if we were asked to make specific charges, we could not do it.

Undoubtedly, to the mind of the youth seeking employment, there is something about the machinist's line that is catching, and as the avenues open to beginners here are more numerous, the greater number make this choice; so, first impressions being the most lasting, they possibly account for the indescribable shade of caste to which we refer.

It requires no argument, we think, to show that there is scope for skill in the molding room or smith shop as great as that found in any of their kindred branches.

This was forcibly shown by the estimate recently placed on a foundryman by a proprietor in search of a manager for that department. He was told of one that could be had at $1,200 per annum, but said he did not want a $1,200 man. "If I can find," said he, "a $2,400 man I will take him."

The machinist who becomes master of his business has, of course, much to be proud of. But he must bear in mind that the skill which enables him to measure to the five-thousandth part of an inch, by the use of a delicate instrument, is not greater than that of the blacksmith, which enables him by his eye alone, to come within $\frac{1}{32}$ of an inch (a smaller fraction than he is usually expected to use) in hammering a piece of iron perfectly square.

We once knew a machinist whose lack of confidence in himself was so great that he would caliper a thing over and over, and even then seemed uncertain as to whether or not he was right.

It is a good thing to have an eye that will tell us very nearly when a thing is right, and it is also important to know when "very near" will answer, and when to be exact. An *over nice* workman is sometimes the most unprofitable, especially in the jobbing shop, for here his sense of what constitutes good work is sometimes greatly outraged. He runs a planer, perhaps, and the foreman brings him a piece of work to plane and follow up to a finish. It is like Fig. 1. "But," says the foreman, "plane it so that it will work all right without any filing or scraping; these take time, and our customer will not pay for it."

Another workman gets a job that puzzles him a little. It is a plain casting a foot square; it is to be planed *perfectly* true, and all corners left sharp. But there must be but one cut taken off.

It is a right good thing for a workman

who has been brought up in one of those shops where they have all the time they want, to get into a job shop where he may get a move on him. He will probably find it quite as difficult to unlearn some things

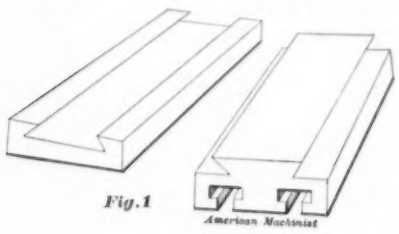


Fig. 1

Fig. 2

as the job shop man finds it to learn the art of doing good work, when he comes to have it to do.

A mistaken notion prevails, we think, among some machine men, as well as those who cannot be expected to know any better, that high speeds are necessarily destructive to machinery.

It may be possible to demonstrate theoretically that this is not so, but practical proof is better. We must, of course, take it for granted that a machine is properly constructed, and in fairly good working order. It is clear that a dry journal, running rapidly, will cut out quicker than one running slowly, and 200 thumps a minute in an engine will do more harm than 100 in the same time.

Take a lathe, for example, which is usually well constructed, and has good care. The main gear on the spindle, and its pinion, will generally show more wear than their counterparts, at the other end of the cone, which move three or four times as fast.

Some shop experience came to the attention of the writer recently, which may be worth relating: An old lathe was being repaired, and the spindle gear must either be re-cut, or replaced with a new one. It was determined to reduce its diameter one-eighth of an inch and re-cut the teeth. A new pinion was to be made one-eighth larger than the old one, to make up for the reduction in the wheel. The gears being 8 pitch added one cog to the pinion. The relative pitch diameters of these wheels are shown in Fig. 2. The work had not progressed far when a snag was struck, which perhaps has wrecked other barks. The wheel when re-cut would be a fraction more than 8 pitch, while the pinion would remain exactly 8 pitch. A somewhat puzzling question to present itself, especially to one not fully up in the mathematics of gear cutting. It was obvious that these gears cut in this way would not work well, and it was equally clear that there was a mean between these two pitches, which, if found, would solve the problem as to the proper pitch diameters of the two wheels. The way out of the dilemma was easy when once learned, as the following well-known formula shows, and in which d = distance between centers in inches; c = number of cogs, and p = the diametral pitch in inches. Then $p = \frac{c}{d \times 2}$ or $d = \frac{c}{2\ p}$, so that with the fixed factors in the above problem we have $\frac{80 + 25}{6.5 \times 2} = 8.077$, the required diametral pitch for the two wheels.

Then for the diameter of the large wheel we have $\frac{80}{8.077} = 9.904''$, and for the pinion $\frac{25}{8.077} = 3.096''$, their combined diameters being, as before the change, 13 inches.

The work was done on this line, and proved satisfactory.

We have been both amused and instructed by the views of your contributors on the subject of computing horse-powers of steam engines. We wonder whether these gentlemen know how this is done out West, especially in estimating the power of portable engines. The formula is so simple it need not be expressed in algebraic terms. They simply square the diameter of the cylinder, and divide by four as a constant.

A 10-inch cylinder, of course, gives 25 horse-power. If it does not do it at the blowing-off pressure, they hang on pieces of grate bars, and make it do it.

"Quirk."

Further Light Wanted on Scientific Hardening.

Editor American Machinist:

Mr. Simonds' article on "Hardening Steel" I have read with interest and greatly wish for further information. Will Mr. Simonds tell us just how he rigged up to make his tests and how they were made, and, above all, how much was gained by his careful study and application in the actual cutting properties of the tools? Further, will he not name the make of tool steel he experimented with?

In our everyday mechanical life we find many very serious questions to answer correctly, and it seems to me the fewer we have to answer the more carefully we can consider each individual question.

To me, taking up the question of hardening steel by any method other than is now generally employed is a serious matter, and one in which the cost of the candle and the value of the game must be seriously considered.

That overheating changes steel no one will doubt, but to what extent does the ordinary treatment of steel injure it, if at all? If you take certain brands of tool steel you will notice the label calls for a special color for hardening, and, as Mr. Simonds remarks, it may be "a cherry red" or "a low red," or anything the maker's thought suggested for the proper heat. On others no special directions are noticed, and my experience goes to show that the steel which requires a label to tell how it should be treated is rarely satisfactory.

Take Jessop's and Firth's and let any apprentice boy make himself proud by heating and hammering it until he has produced a tool of uncertain style and questionable value and ten to one it will be found to cut very well indeed.

If, however, he tried his hand on a steel labeled to be worked at a low heat he would have a stub with a burnt end which would crumble away the moment it touched the work.

Leaving out the air-hardening steel, I have found that about any steel which will harden at all will do good work, irrespective of where it was made, if fairly well hardened and drawn, and that the difference between the most expensive kind and the miserable stuff put in files is, for the usual work of a machine shop, very little.

This statement refers to lathe and planer tools only and not to cutters for milling machines, or for taps or reamers, or for very heavy work.

There is no set of business men who take greater risks than steel manufacturers, as their product must always receive part of its treatment at the hands of strangers, and yet the makers are supposed to and do guarantee results.

Steel may require to be heated to an exact temperature to be at its best, but I do not believe there is enough difference in results between the tool so heated and the steel treated, as it will be 99 per cent. of the time in the hands of a good smith, to be worth speaking of. Nor does it seem that any more uniform results would be obtained, as the apparatus which was to produce perfect results has never seemed to work when I have been called to inspect it.

I consider the smith a king among artisans, and that he is so little affected by the mechanical advances of to-day is not because the smith does not advance, but because he has been so far ahead of his fellow craftsmen that they are not yet abreast of him. As far as can be learned, the work done by a first-class smith 25 years ago was as well and quickly done as it is now. If he has improved at all it is in tempering tools, as larger cuts are demanded.

No doubt improvements have been made in the steel itself, but its value will far more depend upon its intelligent treatment than on its quality.

To use the system proposed or employed by Mr. Simonds the temperature best for hardening each steel will have to be stamped on it by its maker or be determined by a series of experiments; and even if this is done I do not see how it will be of practical value, as, for instance: Would a set temperature for a steel give good results if the first article to be hardened was a taper reamer and the second a twist drill? Would not an equal amount of intelligence be required to judge each article as is now demanded?

It may be answered that a reamer and a twist drill should not be made of the same steel, but the refinement of half a dozen kinds of steel is not practical in most shops.

There is very little trouble to-day in tempering tools so as to make them stand all that is generally asked of them. Where this trouble of poor temper occurs once, the trouble to make machinists run their tools fast enough to put anything like a severe test on their hardness occurs many times.

If Mr. Simonds' method will insure more even results with more certainty he should be proud and the mechanical world should be thankful.

It seems to the writer that all that is gained is in having a furnace in which more even heats can be obtained instead of the smith's open fire, and that it will take as much skill as ever to produce the best results, barring the even heating, which is a matter most well-equipped shops are little troubled with. More information from Mr. Simonds will be greatly appreciated.

Hoboken, N. J. W. D. Forbes.

Oiling Ball Bearings.

Editor American Machinist:

Referring to recent letters in your paper in regard to oiling the ball bearings of bicycles, it would seem that, mechanically considered, oil is not necessary. The writer recently thoroughly cleaned both sets of ball bearings on the rear wheel of a bicycle and supplied oil in a very small quantity to one set of bearings, the other set being left without oil. A three or four-weeks' use of the machine developed a decided "squeak" in the rear wheel, and upon investigation the set of balls on the side containing the oil were found to be in good condition, while the set of balls on the unoiled side were covered with rust, turning the balls and the cone into a bright mahogany color.

To the writer's knowledge, no moisture could have penetrated to the unoiled set of balls from the outside, and it is therefore probable that the moisture which caused the rust was due to condensation on the inside of the bearing.

It would seem, therefore, that although the non-oiling of ball bearings is practical from a mechanical standpoint, it is practically unadvisable, and that a slight film of oil is necessary to prevent oxidization.

Jno. H. Noble.

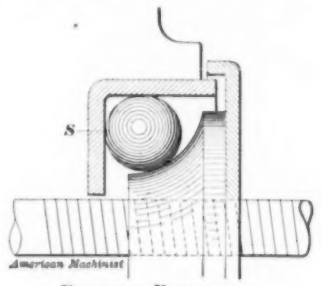
Editor American Machinist:

I was reared in the belief that ball bearings, whether large or small, thrust or ordinary, need oil; however, in view of your first article on the subject, I concluded to make a tentative examination of the merits of dry bearings. At first they ran easily and quietly, though showing, it seemed to me, brighter tracks than usual on the cones and cups. Then came a moist day and a suspicion of grind and uneasiness and more muscle. Search showed up a rusty main bearing with unnecessarily wide, bright tracks in both cone and cup, though none of the balls seem damaged.

It is so nice to always have our nickel and enamel free from dusty oil tracks, that we are tempted to bite on anything that purports to save labor; and it is so easy to get an allopathic dose of oil out of a homeopathic oil can. In my own case, I have found nothing better than a little vaseline, applied when the wheel is cleaned. It doesn't run, guards against moisture, wears well and need not be applied more than once a fortnight, when the bearings are cleaned (or ought to be). Novice.

Editor American Machinist:

I have been much interested in the remarks and experience of your correspondents about running their bicycles without oil; and while they have been successful, as they say they have, and I have now in mind the constructive details of several styles of bicycle bearings, which to my mind would likely give better results without oil than with it, yet for myself I shall still continue to use oil, and I think that when suitable oil is used and the bearings are properly fitted for the exclusion of dust, oil will give the best results. But to exclude dust not one



Bicycle Bearings.

of the many so-called dust-proof bearings depending wholly on mechanical fits, or peculiarity of form, has been an unqualified success for shafts and wheels. The outer end of pedals with a cap fitted to either screw or press on, comes the nearest to it; but here is an easy chance to accomplish this.

For the inner end of pedals, crank shaft and wheels I have so far seen nothing to equal a simple felt washer, and this is even more effective when it gets saturated with oil.

I know they have been condemned by many riders because they, in many cases, add a little extra friction, and a wheel will not whirl quite so long with as without them, but the real fact is that the ease with which some or all parts of a bicycle move when held up in the air and without load is not a sure sign they will do the same when in actual use and for several days together out on the road in dust and mud.

It is a mistake to suppose that in a ball bearing as commonly made the friction is all rolling—no sliding, except between the balls themselves. It might be possible to very nearly eliminate friction in a new bearing without load, if great care were taken in its make-up, but ordinary bicycle bearings very soon show a track of appreciable width in which the balls run. It is sometimes of considerable width, and in the ball case in hub of wheel two tracks are often seen, while on the cone there is but one as in the sketch. You may say this is an extreme case as shown, but I can name the make of wheel and show you a pair of cases removed from one of them, like sketch.

Now it is easy to see that the ball will be controlled in its motion by the greatest pressure, which will be in a nearly vertical direction, and it must of necessity slip on that part of its bearing toward the center of machine or at S in sketch. If it slips under pressure there must be friction and some wear, and I believe mechanics teaches that friction is less between lubricated than between dry surfaces. One more point: A rider, in the country at least, is liable to be caught out in the rain, and in such a case the water will get into almost any bearing. Good oil in there first and plenty of it—I mean by this, as much as would ordinarily be used by a careful man—will have a tendency to keep the water out and to prevent damage by what does get in. Metal perfectly dry and clean is in the best condition to be attacked by rust.

I have just examined my bicycle bearings for the first time since putting the cycle together in the spring, and I found no gummy

oil, dirt, paste or other uncleanness in them; the balls looked like mirrors, each and every one; the bearings are protected by felt washers.

I am no doubt considered old fogy in this felt-washer-and-oil idea by many, yet I shall continue to use them both until I find a frictionless bearing and some sure way to keep the water out of it for a bicycle.

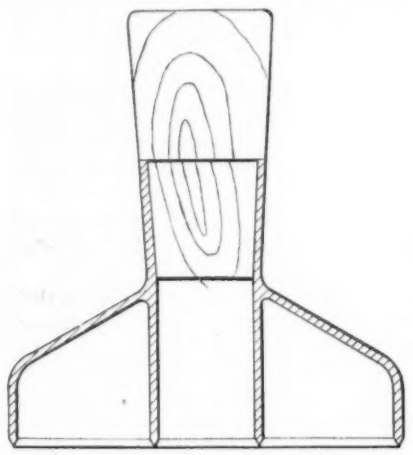
CHARLES S. BEACH.

A Gasket and Washer Cutter.

Editor American Machinist:

In almost every shop circumstances often arise that, were it not for the expense, small tools for special purposes might be constructed to save time and labor. Often the article to be produced is needed in small quantities, and at intervals of considerable time. Then it becomes a comparison of the value of the labor saved by the tool and interest on the money invested, together with the depreciation of the value of the tool.

The following is the description of a small tool which might have had the above consideration; at any rate, it proved to be a successful labor-saving device. At one time



its plan of construction was used for a pipe gasket cutter, and at another time for cutting paper and other insulation in electrical work where there was great variety in shapes and sizes.

The tool was simply a shell of malleable iron, the thickest part was not one-eighth of an inch. All cutting edges were cast in shape, and when tooled as little metal as possible was taken off. Up to six inches in diameter they had sockets like an ordinary carpenter's chisel to receive wooden handles to be driven by a mallet like a wad cutter. With proper usage their endurance was surprising; while their cost was wonderfully small, especially the round ones, which required very simple tooling. The same device with little modification may be put to many other uses. J. LANDSING.

[Several years ago Jno. J. Grant showed in these columns a similar tool for making paper washers for spacing milling cutters upon the arbors.—ED.]

To Young Engineers.

Editor American Machinist:

With your permission I would like to say a word to young engineers.

At the present time the installation of large numbers of steam plants all over the country naturally causes a great many young men to look forward to the time when they each can take charge of a plant as a full-fledged engineer. A great many arrive at that point, and many fail, but if the young aspirant starts in the right direction and keeps in the proper path, success awaits him. In the first place, to be a good engineer a man must be a machinist, and possess all the knowledge of a first-class machinist. Should, for instance, possess a fair knowledge of mechanical drawing, working of iron or steel, and strength of materials. Then he is in a position to learn the various points pertaining to the operation of engines and machinery in general, which will come to him easyily and thoroughly, if he has, in the first place, a hankering, as it were, for mechanics, backed up with the knowledge mentioned previously. The traits to be cultivated are caution in all undertakings, and close attention to your duties, no matter what position you may hold; at the same time finding time to keep an eye on the methods pursued by those known as good operating engineers. Do not confine your observations to one engine room, but get into and around all you can; visit modern steamships and study them, as you will learn much from close observation, and conversation on engineering subjects always pays both old and young engineers. Keep constantly thinking of advancing the calling, as ambition is what is needed to be successful. A MACHINIST ENGINEER.

The Term Monkey Wrench.

Editor American Machinist:

For the benefit of Mr. Foote, who desires in the last issue of the MACHINIST to know the origin of the "monkey" wrench, so-called, I would say that the wrench was the invention of Charles Moncky, who sold his patent for the sum of "two thousand dollars," with which money he purchased a house in Williamsburgh, Kings Co., New York, in which house he now lives, or at least did when I last saw him in 1890 or 1891. The name has simply been misconstrued from Moncky to monkey. I write this explanation hoping that it may settle in the minds of many the question which has been so many times asked and which none seem able to answer.

W. B. WILBER, M. E.

Stamford, Conn.

Car Brakes—Cut-Off on Corliss Engines.

Editor American Machinist:

F. M. James thinks that stopping a street car instantaneously would be the same as a collision.

A good, quick-acting brake if applied suddenly has the effect of throwing the passengers over the seats and is an unpleasant sensation, as those having experience know, but is preferable to the taking of human life. Cars equipped with these brakes are unpleasant to ride on unless the motorman uses judgment in applying them.

A car equipped with these brakes can make better time, but it will be more expensive for the reason that it is difficult to make the ordinary motorman understand that a wheel sliding on the track does not hold, and they get in the habit of allowing a certain distance for a stop, regardless of the condition of the track, with the result that they slide the wheels a great deal and the annoyance and expense of flat wheels is quite an item. It is the flat-wheel business, sometimes requiring new wheels in two months, that makes the use of air or electric brakes a thing to be dreaded by street railway managers.

A car equipped with an electric brake and running ten miles per hour can be stopped in a distance of fifteen feet on an ordinary track, and a car thus equipped and running at that speed, is safer than a car running six miles fitted with the ordinary brake.

In No. 357 you reply to "W." that the Corliss engine "will not respond to its governor unless the cut-off takes place before ½ stroke." This is true of most Corliss engines, but there are Corliss engines running that will respond to the governor for ¼ stroke, and when you get to ¼ stroke there is but little left for further regulation. If you can hold a Corliss valve open to ¼ stroke, a piston making 650 feet per minute will make the extra ¼ stroke while the dashpot is getting ready to drop, no matter how lively you make it.

It is claimed for the high-speed engine that the steam is used quicker and results in less condensation. With a piston speed in both cases of 650 feet per minute, how much faster is it used in one case than in the other?

An engine can do no work when on the center. An engine running 300 revolutions per minute will be on the center 600 times per minute, while an engine running 75 revolutions will be on the center but 150 times. Assuming that both have the same clearance, the first will have filled and emptied its clearance spaces 600 times to the latter 150 times. W. E. CRANE.

Waterbury, Conn.

Smith & Black's Big Lathe.

Editor American Machinist:

One day while I worked at Smith, Black & Company's a job came in, that, had I been alone, I should have turned away, but the old man was there, and he made it a point never to turn any job away.

It was eight large spiders to bore out and set-screw, no turning, as they were to be covered with wooden lagging and then turned off after being set in place on the shaft. They were about 8 feet in diameter, and our big lathe would swing but 3 feet. I worried over the job all the afternoon. The old man did not seem to fret much—he seemed to be more anxious to get a good day's work out of me, I thought.

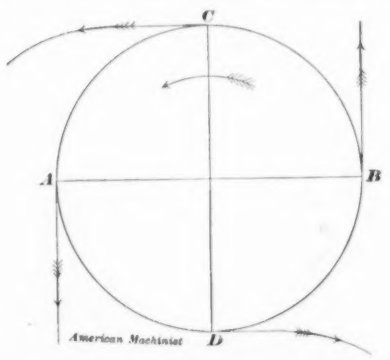
The next morning he came in and had us turn the head stock on the 24-inch lathe around so the face plate would swing over the end of the lathe, and cross the belt so it would run right-handed, and one of the eight spiders was put in place on the face plate and trued up. We had in the shop a brass lathe with a milling vise and spindle on the stern end of it; this was backed around until the feed stood at right angles to the ways of the big lathe, a heavy boring tool was clamped in the vise, and I was attached as an automatic feed motion, and a cut started. The tool would spring away from the work, owing to the floor being out of level, but the scale once out of the hole, good time was made on the job and the set was put through in short order.

Years have passed, and of the whole rig the "feed motion" is the only part that has kept up with the times, and even that, I find, is getting rusty. A. P. PRESS.

Radial Icicles.

Editor American Machinist:

I am surprised to find my friend, Sweet, going astray on this question, and can only say that if ten thousand observers will watch the water flying off from the faces of ten thousand grindstones, they will each and all see just the action represented on



the accompanying diagram. Disregarding all other points of the circle, will these ten thousand observers confine their attention, please, to four points, namely, the top, bottom and the sides, that is, to the extremities of the vertical and horizontal lines passing through the axis of the wheel. This is what they will then see: At the point *A*, the drops of water will fly downward in a straight line. At the point *B* they will fly upward in a straight line: At the points *C* and *D* they will describe curves, the form of which depends on the velocity with which they are thrown off, but always starting in a horizontal line. All these lines are at first tangent to the face of the stone, and afterwards show the motion, after leaving the stone, of the free drops of water, or how the original direction of their motion is changed, under the action of gravity, similar to the trajectory of a shot.

"The old notion that particles leaving the periphery of a revolving wheel by centrifugal force go off on a tangent," is, I beg to assure Professor Sweet, just as safe from being "exploded" by "the discussion of your correspondents," or by the Professor's "fancies," as is the "old notion" that the earth is round. CHARLES T. PORTER.

The Unprofitableness of Overtime.

If a proprietor is ever to be found in favor of running over hours he will generally be found to be one who does not go much into the details of the cost of his product. The following figures from the *Northwestern Lumberman* speak for themselves, and we have no doubt that parallel results could be found in machine-shop records if those records could be kept with completeness and precision. The figures given are from the West & Slade Mill, of Aberdeen, Wash., and they represent the daily cut of an Allis band saw mill for the month of August. For 12 days of the month they ran 12½ hours a day, and for 15 days they ran 10 hours a day:

August	1	58,941 feet,	12½	hours
"	2	67,896 "	12½	"
"	3	50,512 "	12½	"
"	5	59,560 "	12½	"
"	6	59,330 "	12½	"
"	7	50,414 "	12½	"
"	8	54,724 "	12½	"
"	9	59,337 "	12½	"
"	10	47,815 "	12½	"
"	12	49,706 "	12½	"
"	13	47,345 "	12½	"
"	14	58 336 "	12½	"
"	15	55,708 "	10	"
"	16	54,544 "	10	"
"	17	42,000 "	10	"
"	19	54,653 "	10	"
"	20	54,274 "	10	"
"	21	55,087 "	10	"
"	22	54,559 "	10	"
"	23	51,382 "	10	"
"	24	53,350 "	10	"
"	26	50,564 "	10	"
"	27	50,412 "	10	"
"	28	46,956 "	10	"
"	29	59,595 "	10	"
"	30	68,474 "	10	"
"	31	63,846 "	10	"

It will be noticed that the average cut per day of 12½ hours was only 549 feet greater than the average for 10 hours, while on one 10-hour day the cut was greater than for any 12½-hour day.

A Correction.

An error occurred in our description of the Cincinnati Milling Machine Co.'s new milling machine, published in issue of October 3d. The total number of feed changes is twelve, as we gave it; but only two changes are obtained by the shifting lever, instead of three, as we stated, and to get the twelve changes there is a change in position of the gears besides the shifting of the belt on the feed cones, which have three steps instead of four.

Death of Dr. J. C. Pohle.

Dr. J. C. Pohle, best known as the inventor of the Pohle Air-Lift Pump, died in this city on October 7th. He was born in Berlin in 1829. His earlier years were spent in this city, where he studied, and later practiced, medicine. He was State Geologist of New York from 1860 to 1870. About twelve years ago while managing a silver mine in Colorado his experiments developed and perfected the air-lift pump, which is not a pump, or at least has no valves or working parts, but is an efficient means of raising water, within certain limitations, by the direct use of compressed air. Lately his time had been given to the introduction of the pump.

Mr. J. C. Parker, Superintendent of the Detroit Dry Dock Company, died on the 18th inst. He was 53 years of age and had been connected with the establishment nearly 30 years.

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☞ *Every correspondent, in order to secure attention, must give his full name and address; not necessarily for publication, but as a guarantee of good faith.*

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Perfection of Workmanship.

It is said that some of our explorers who have set out at different times to reach the North Pole would not have known when they had got there, if they had ever succeeded in reaching it. Would we know perfect workmanship if it was ever attained? It is a rather curious fact that while we are thinking and talking (two operations that do not always go together) about perfection of workmanship, we are pursuing perfection by methods which entirely exclude the idea of perfection, and indeed render it absolutely impossible.

"The clock strikes one;
We take no note of time, but from its loss."

and so our systems of corrections and gages take no note of perfection of product, except through our failures to reach it. Perfect uniformity of speed in a steam engine is an idea easily conceivable and capable of perfectly clear definition; yet all our devices for governing are based upon the principle of correcting variations of speed after their occurrence. No governor in existence can possibly produce a perfectly uniform speed, because it will not begin to perform its function until variations of speed have actually occurred, and it employs the variations of speed as the means of correction. It acts after the fact instead of before it, and deals with imperfections exclusively. So when it comes to accuracy or perfection of workmanship, we find the same idea still dominant. No lathe will automatically turn a piece upon the centers perfectly parallel or absolutely of the required diameter. The centers are not usually exactly in line with the shears; the piece, if of much length, springs away from the tool variously at different points, and the varying density of the metal also causes the pressure of the tool to have different effect at different spots, and so, in order to get the work as accurate to size as possible, not perfect, the latheman has to stand over it with the calipers to detect the inaccuracies, and, as nearly as may be, to correct them. Then we investigate the ability of the man to detect minute differences of size, that from it we may estimate not the possibility of his ever producing perfect work, but the closeness of his approximation. He is a very poor latheman, for instance, who cannot with common calipers detect a difference of a thousandth of an inch in diameter. This workman with his calipers stands over the piece as it is being turned in the lathe to detect the differences in its diameter that are constantly occurring, and to change the cut according to the indicated needs, but always after a certain portion of the work has been turned slightly too large or too small. If we use "doctors" or sizers to finish external diameters, or reamers to finish holes with, we always encounter the same trouble. All our tools when in use are constantly wearing, and no two pieces produced by them are ever of precisely the same size, so that, instead of attaining perfection, our very best devices still scarcely bring us within sight of it. The dream of the mechanic is the perfect interchangeability of manufactured parts, but interchangeability of parts, as understood and practiced, never means absolute identity of parts in shape or dimensions, but always an approximation within limits more or less defined. We may continually reduce the range of permissible variation, and so also continually advance the excellence of our work, but it is evident that if perfection is ever to be attained some one is yet to arise to show how it is possible to attain it, for at present no mortal knows the way.

Roller Bearings.

Our attention has been called to two instances of the use of rollers in bearings, the results of which are significant in some respects, but at the same time are likely to be and, in fact, are being misinterpreted in some quarters.

The first of these cases is in the shops of the Brown & Sharpe Mfg. Co., where a set of rolls used for rolling sheet steel, cold, were first operated for some time with ordinary bearings, and were then equipped with a set of roller bearings. Previous to the change a 6-inch belt running over a 24-inch pulley on the machine had been found inadequate to drive it, and a 4-inch belt had been placed over it. The two belts arranged in this way had driven the machine, but it had been found impossible to run more than a few hours at a time on account of heated bearings.

After putting in the roller bearings, it was found that a 1-inch belt would drive the machine when doing the same work, and we recently saw a 2-inch belt driving the machine, and were informed that it was regularly used, running on the same pulley. It had been found unnecessary to stop on account of hot bearings, and the speed had been increased 25 per cent.

There is here shown such an enormous advantage in the use of roller bearings as to make the plain statement of the facts of the case seem like a fairy tale, but we can vouch for its accuracy in every particular. It shows what a very great advantage may be gained by roller bearings in some cases, and also shows what a very large proportion of the total driving power applied to rolls, when used on such work, is consumed in overcoming frictional resistance in the machine. The pressure required to slightly reduce the thickness of a strip of hard tool steel six or eight inches wide is, of course, very great, and yet the actual foot-pounds of energy required to do it must be small. The consequence is that the great pressure upon the bearings causes corresponding frictional resistance in them, which consumes practically about all the power applied to the machine, and thus gives to the roller bearings a chance to make perhaps their very best possible showing. In a machine where the actual work to be done required more power, and the frictional resistance less proportionately, the showing might be expected to be very different.

Such a case, and one more nearly representing the average condition under which comparisons will be made, is to be seen at the establishment of the Wm. L. Gilbert Clock Co., at Winsted, Conn., where their 600 feet of line shafting had 104 bearings of the usual type, lined with babbitt metal, and these bearings were replaced by roller bearings. The shafting is driven by a 40 horse-power water wheel, and, according to brake or dynamometer tests made by Messrs. Geo. B. Woodruff, assistant superintendent, and T. W. R. McCabe, master mechanic, 25.02 horse-power of this was absorbed by the frictional resistance of the line shaft when using the old bearings, as against 18 horse-power with the roller bearings, thus saving 7.02 horse power, or 17.55 per cent. of the whole power developed by the wheel, and 28 per cent. of the original friction of the line shaft.

This gain means even more to them than the figures would indicate, because it happens that the water wheel was not able to keep the shaft quite up to its proper speed with the old bearings, there being some deficiency of power, while with the roller bearings there is plenty of power, and full speed is maintained, so that the production of the factory is materially increased.

While we do not think that roller bearings will entirely supersede the other forms of bearings now in common use, it is likely that the ordinary bearings are now being used in many cases where it would pay to use the rollers, and we think likely that roller bearings are destined to become a more prominent feature of machine construction than is now the case.

Some Points About Trade Journalism.

Our heartfelt sympathy is hereby extended to a number of our esteemed contemporaries whose virtuous indignation and righteous wrath have been aroused by the very reprehensible conduct of certain machinery manufacturers who have secured the free publication in the reading columns of our aforesaid esteemed contemporaries of various and sundry illustrated articles prepared by the previously referred to machinery manufacturers. These reprehensible men have, it seems, secured the publication of many pages of such matter *under the pretense that they intended to advertise*, and have then refused to advertise, or have gone to the magazines to do their advertising. Many of the victimized papers are publishing the same caustic editorial regarding this matter, and we think likely that before they get through with it some of these wicked manufacturers will feel quite ashamed of themselves.

The editorial is entitled 'Working the Press," and our esteemed contemporaries seem not to realize in the least that by publishing it they are clearly showing their own weakness, and letting everybody know (what is really the fact) that they publish such articles for manufacturers solely with a view to actual or possible advertising contracts, and absolutely without regard to the interest or novelty of the matter published.

So far as the American Machinist is concerned, we try to have it thoroughly understood that no manufacturer is under the least obligation to advertise in this paper, because we have published or may publish an illustrated description of a machine built by him.

So long as there is a lot of so-called "trade papers" clamoring for opportunity to publish anything, no matter how old or how absurd, if there is a chance of advertising contracts with the parties interested in it, so long will manufacturers continue to take advantage of the situation. And who shall say them nay?

The only criticism we might offer on their course, is that they display bad judgment and a lack of knowledge respecting the value of such "write-ups." In nine cases out of ten they possess no value whatever. A paper which thus prostitutes its columns has absolutely no influence; and, often, *not one single paying subscriber;* its circulation being entirely by free distribution, among people, most of whom pay little or no attention to it, and seldom even glance through it.

As an example of the frightful contagiousness of our "Yankee brag and bounce," an article by Professor Forbes, C. E., of England, in *Blackwood's Magazine*, ought to prove interesting. Professor Forbes was in this country only a few months probably, and yet his article, considered by itself, would convey the impression not only that he is the chief creator of the Niagara power plant, but that he created it and put it in successful operation, handicapped by the perhaps well meant but nevertheless utterly worthless efforts of the eminent Americans who were also engaged in the work.

Of course, no Englishman in his normal condition would indulge in "Yankee bounce and brag," and this sad lapse from British modesty must be attributed solely to the influence of contagion, which we shall hope the professor will soon recover from.

Paymaster Rodney, U. S. N., sends us a large card, headed "Limit Fortunes," and he proposes a constitutional amendment for that purpose. We note that Mr. Rodney says on this card:

Limit omitting unanswerably proves secular law a traitor to man; as it is bent to rapidize and ensafe the financial centripetal forever; thus betraying him eventually back to serfdom.

From this we conclude that his treatment of the subject is entirely too deep for us, and the only thing we feel quite certain about is that it would be useless and worse than useless to attempt to limit private fortunes in any such manner. If we take away the opportunities for building up monopolies under cover of law, men may then safely be left to make as large fortunes as their abilities, industry and economy will permit.

We are much interested to learn from a more or less mechanical contemporary, that in the oval arms of the fly wheel which re-

cently exploded at Hoboken, "the major axis of the ellipse is perpendicular to the shaft." This is very important, and if there is a coroner's jury it should fully consider this point.

Literary Notes.

After November 1st, Mr. M. N. Forney's paper, the *American Engineer and Railroad Journal* will be published bi-weekly, and will appear every alternate Thursday.

International Trade is the name of a new magazine, the first number of which is called the "South African Number," and is devoted to setting forth the possibilities of trade in that quarter of the globe. It is purely commercial in character, and contains a number of well-written articles of interest and value to the merchant. It is published by Henry Glassford, 66 Broad street, New York.

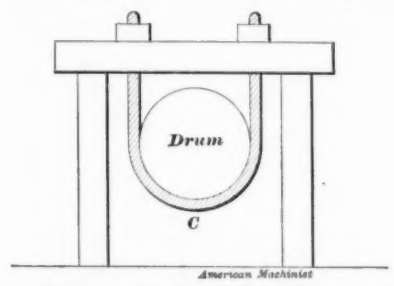
Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet. We cannot undertake to answer questions in "next issue." This department is usually crowded, and questions must wait their turn to be answered. Neither can we undertake to solve mechanical or engineering problems, and send answers by mail.

(371) C. V., Milwaukee, Wis., writes: For the purpose of experimenting, I would like to know whether crude petroleum when made into gas by heat in the retort will carbonize. If so, can it be cleaned off, and how? *A.*—Petroleum when made into gas will leave a residue in the retort, which will have to be scraped out, or cleaned out by mechanical means.

(372) P. P., Philadelphia, Pa., writes: Please inform us how to quickly turn hard rubber on a turret lathe. We find that the edge is entirely taken off the tool so that the process is very slow, and of course it does not pay to take out the tool and sharpen it for every piece. A steady stream of oil on turning does not seem to improve it. *A.*—Turning hard rubber is generally a slow and tedious process, on account of the tools becoming dull. We know of no other way of overcoming this trouble than by selecting a quality of steel suitable for the purpose, and the best way to obtain this is to write to a reliable steel manufacturer, stating the purpose for which the steel is to be used.

(373) M. F. L., Eagle Hill, Pa., writes: A winding drum weighing 25 tons is suspended by a 1⅛-inch steel wire rope as per accompanying sketch. Please show how to compute the stress on the rope at *C*. The diameter of the drum is 8 feet, length of



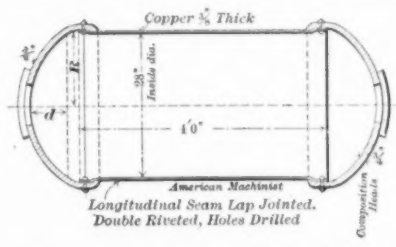
rope 25 feet. *A.*—The stress at *C* is equal to one-half the weight of the drum, 12½ tons, or $12\frac{1}{2} \times 2{,}000 = 25{,}000$ pounds. The cross-sectional area of a 1⅛-inch rope is 2 square inches, hence the stress per square inch is $\frac{25{,}000}{2} = 12{,}500$ pounds.

(374) J. C., Port Oram, N. J., writes: Among my various duties I have some brass unions to secure to copper pipes used on locomotives. I am not experienced in this line of brazing. Kindly inform me what to do or give the title of some good book from which I can obtain the necessary knowledge. *A.*—We do not know of a book which treats exclusively on this subject. The "Art of Coppersmithing," a practical treatise on working sheet copper in all forms, by J. Fuller, contains a few pages relating to brazing work of a character similar to that referred to by you, and may be of aid to you. In answer to Question 312, in our issue of August 15th, current volume, we have given the mode of procedure for brazing, and may be of assistance to you. 2. Do you publish your answers in book form? *A.*—We do not publish them separately in book form; of course they will be found in the bound volumes of the American Machinist, which we can furnish at any time. 3. I would like to have a good book which treats on repairs and maintenance of machinery. Kindly advise me which one to select and from whom it can be procured. *A.*—The "Modern Machinist," by John T. Usher, published by Norman W. Henley & Co., 132 Nassau street, New York, will probably be of assistance to you. 4. I would like to learn to read drawings and blue prints of machinery. I do not aspire to be a draftsman, but would be content to read drawings and work from them. For doing work we always get drawings and it is very inconvenient when one cannot understand them. How can I learn this? *A.*—Read the articles treating on "Practical Drawing," by J. G. A. Meyer, which were published in our columns. We can furnish a complete set of these papers, sent to any address, for $5.

(375) C. R. R., Seneca Falls, N. Y., writes: Please give the safe and the bursting pressure on a copper cylinder of which the dimensions are given in the accompanying sketch. The ends are made of composition. Please give formula. *A.*—The bursting pressure per square inch of the cylindrical part is found by the following formula:

$$P = \frac{T \times S}{R}, \qquad (1)$$

in which P = pressure per square inch, S = ultimate tensile strength of the copper, T = thickness in inches of the copper, and R = inner radius in inches of the cylinder. Assuming that the ultimate tensile strength of sheet copper is 30,000 pounds per square inch, and that the riveted joint reduces the resistance to internal pressure 40 per cent.,



we have for S a value of 18,000 pounds. Substituting for the letters in formula (1) their values, we have,

$$P = \frac{.375 \times 18{,}000}{14} = 482 \text{ pounds}$$

per square inch which will burst the copper cylinder. For the bursting pressure of the heads, the following formula may be used:

$$P = \frac{S \times 4 \times T \times d}{(R^2 + d^2)} \qquad (2)$$

in which d = depth of inner spherical part of the head (not the whole depth of the head), R = inner radius in inches of the base of the head, and S = the tensile strength of the metal, which we shall assume to be 24,000 per square inch, and T = thickness in inches of metal. The depth d, which is not given on your sketch, we shall assume to be 3 inches. Substituting for the letters in formula (2) their values, we have,

$$P = \frac{24{,}000 \times 4 \times .75 \times 3}{14.375^2 + 3^2},$$

which gives us 1,001 pounds per square inch for the bursting pressure of the heads. Taking a factor of safety of 6 for the heads, we have for the safe pressure on them 167 pounds per square inch. Taking a factor of safety of 4 for the sheet copper, we have for the safe pressure in the cylinder 120 per square inch. These results depend much on the tensile strength of the metal, and since we do not know exactly the kind of metal you have used, the pressures as found above may have to be considerably modified.

(376) H. W. B., Philadelphia, Pa., asks: What are the tensile, compressive, transverse, and torsional strengths of cast and wrought-iron, and the factor of safety allowed for each? *A.*—The strength of cast and wrought-iron depends on the quality of the iron. To give the strength of all the different grades will require quite an extensive table, for which we have no space in these columns. You will find tables of this kind in any engineer's pocket-book. For ordinary use we may employ the following: Ultimate tensile strength for cast-iron, 20,000 pounds; for wrought-iron, 55,000 pounds per square inch. The ultimate compressive strength of cast-iron, 90,000 pounds; wrought-iron, 55,000 pounds per square inch. Ultimate torsional strength for cast-iron, 25,000 pounds, and for wrought-iron 50,000 pounds. The average quiescent breaking load of rectangular cast-iron beams supported horizontally at both ends, and loaded at the center, and including the weight of the beam, 1 inch square and 1 foot clear length between the supports, is 21,000 pounds. Wrought-iron beams generally do not break; a beam 1 inch square and 1 foot clear length between the supports will be strained to its limit of elasticity by a quiescent load of about 2,250 pounds placed at the center of the beam. We prefer not to use the last two constants or coefficients in computing the transverse strength of beams, but prefer to use the constants or coefficients given for tension and compression, and employ the following fundamental formula:

$$M = \frac{S \times I}{c}, \qquad (1)$$

This formula holds true for any section of any beam, I being the moment of inertia of the section about its neutral axis, c the vertical distance in inches from that axis to the remotest fiber, S the tensile or compressive unit stress on that fiber, and M the bending moment of all the external forces on one side of the section. The value of I can be found in any book treating on the strength of material, or in engineers' pocket-books. For instance, for a rectangular beam the value of I is $\frac{b\,d^3}{12}$, in which b = breadth of beam in inches, and d = depth of beam in inches. For this class of beams c given in formula (1) is equal to $\frac{1}{2}\,d$. Now substituting these values for the corresponding letters in formula (1) we have

$$M = \frac{S \times b \times d^2}{\frac{1}{2}\,d \times 12}, \qquad (2)$$

This reduces to

$$M = \frac{S \times b \times d^2}{6}. \qquad (3)$$

For beams fixed at one end and loaded at the other, $M = W\,l$, in which W = load in pounds, and l = clear length in inches of the beam from support to load. Hence for a beam fixed at one end and loaded at the other, we have

$$\frac{S \times b \times d^2}{6 \times l} = W. \qquad (4)$$

For a similar beam uniformly loaded

$$M = \frac{W\,l}{2}; \text{ this gives us}$$

$$2 \times \frac{S \times b \times d^2}{6 \times l} = W. \qquad (5)$$

For a beam loaded at the middle and supported at the ends

$$M = \frac{W\,l}{4}, \text{ hence}$$

$$4 \times \frac{S \times b \times d^2}{6 \times l} = W. \qquad (6)$$

In which l = clear distance between supports. For a beam uniformly loaded and supported at the ends

$$M = \frac{W\,l}{8}, \text{ hence}$$

$$8 \times \frac{S \times b \times d^2}{6 \times l} = W. \qquad (7)$$

These formulæ are, of course, for rectangular beams. For beams of circular, triangular, or any other section, we deduce, in a similar way, a working formulæ from the fundamental formula (1). For cast-iron the value of S in the above formulæ is generally taken at 5,000 to 6,000 pounds for safe quiescent loads, and for wrought-iron, 10,000 to 12,000 pounds. For a shaft subjected to torsion a fundamental formula similar to (1) is used, thus

$$\frac{S \times J}{c} = P \times p, \qquad (8)$$

in which S = a constant obtained by dividing the constants of torsion as given above by a suitable factor of safety, J = polar moment of inertia of the cross-section, P = a force acting on the end of a lever, and p = distance or length of lever in inches from the center about which twisting takes place to the point of application of the force, and c = distance from the center to the remotest part of the cross section. For round shafts

$J = \frac{3.1416 \times d^4}{32}$, and $c = \frac{1}{2}\,d$, in which d = diameter of the shaft in inches. Substituting for the letters in formula (8) the corresponding values and reducing, we have for round shafts

$$.1963 \times S \times d^3 = P \times p. \qquad (9)$$

With the aid of this formula a round shaft subjected to a given moment $P \times p$ may be investigated, or the proper diameter of the shaft to resist given forces can be determined. The factor of safety depends upon the importance of the structure, its temporary or permanent character, and the degree of vibration to which it will be exposed. For a steady load a factor of safety of 6 for cast-iron and 4 for wrought-iron may be adopted. For a varying load, 10 for cast-iron and 6 for wrought-iron; for shocks, 15 for cast-iron and 10 for wrought-iron. 2. Please inform me what materials to use for cleaning copper work. *A.*—You can use a solution of oxalic acid for cleaning, and then rinse with water.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear Wheels, Gear Cutting. Grant; see page 832.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Patent Solicitor. J. G. D. Mack, Madison, Wis.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Engrs. should investigate the Korting Condenser. Obtain Catalog from A. Aller, 109 Liberty St., N. Y.

Marine Iron Works, Chicago, builders of steam yachts and marine machinery; catalogs free.

Squaring and Rotary Shears, Tinsmiths' Tools, Presses and Dies for sheet metal work, are made by the Niagara Stamping and Tool Co., Buffalo, N.Y.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

Key Seaters for any length of hub or width of keyway. New, handy machines. Mitts & Merrill, 913 Tilden street, Saginaw, Mich.

"Practical Drawing," by J. G. A. Meyer; used by engineering schools in lieu of text-book; the set of 92 papers sent to any address in the United States for $5. American Machinist, 203 Broadway.

Three valuable books by Prof. N. Hawkins—"Calculations," $2.50; "Instructions for the Boiler Room," $2.50; "Aids to Engineers' Examinations," $2. Sold on installments. Write for terms and catalog. Theo. Audel & Co., 91 Liberty St., N. Y.

Engineers and firemen "The Steam User's Guide" answers all questions asked by a board of examining engineers. Price, postpaid, $1.50; 24 p. pamphlet, explaining contents of book, sent on application. C. G. Krell, 13th and Palm Sts., St. Louis, Mo.

Explosion of a Fly Wheel.

A terrific fly-wheel accident, with fatal and widely destructive results, occurred at the power house of the Hudson Electric Light Company, Hoboken, N. J., on October 5th. The accident happened about 3.30 A. M., when there were but seven men in the entire building, and the only one who could have given a clear account of the catastrophe was instantly killed. The wheel which exploded was the driving wheel of a vertical compound Corliss engine of about 500 horse-power. It was upon the center of the crank shaft of the engine and between the two upright frames. It was 20 feet in diameter, 51 inches face, carrying a 4-foot belt and weighed about 50,000 pounds. The normal speed of the engine was 125 revolutions per minute, and the simple cause of the accident was the running away of the engine. The speed attained must have been greatly in excess of the regular speed, as was evidenced by the results of the explosion. Right over the wheel was a platform connecting the two cylinders and giving easy access to the valve mechanism, and the engineer in charge was standing upon this platform. His mangled body was found hanging over a roof truss; one other man was struck by the flying missiles and two others were hurt in their rush to escape. The engine room is a long rectangle running east and west, with the broken engine at the west end of it, a larger horizontal engine next, and an engine similar to the first still farther to the east. All the lines of shafting run east and west. The boiler room is north of the engine room, separated by a brick wall, and the dynamo room, two stories, is south of the engine room. The tops of the engine wheels run south, or toward the dynamo room. The main belts run into the lower story, which is on a level with the engine room, while the second story is filled with dynamos driven up through the floor. Two of the roof trusses of the engine room are over the two cylinders of the smashed engine, while there is no truss directly over the exploded wheel. When the wheel went to pieces, which it seems to have done all at once, the flying pieces seem to have swept and destroyed everything in the actual plane of the wheel. One piece weighing about a ton and a half went through the wall of the boiler house, up through the roof, and about 750 feet to the north, passing over a couple of canal boats. Another piece, of about equal weight, went through the wall of the dynamo room, through the roof and 250 feet to a paved street, where it plowed a deep

hole. Other pieces of various sizes smashed pulleys, bent shafts, and wrecked everything in their path within the building. The steam pipe was broken off, and the building was filled with escaping steam and left in total darkness, while the noise of the occurrence aroused the inhabitants for a mile around. The wheel, for a cast-iron wheel, was apparently as strong and as well made as could be reasonably expected, the detail most likely to provoke criticism being the manner in which the arms were fastened to the hub, although portions of all the arms remained in the hub through it all. The rim of the wheel was in eight sections, the flat periphery being about 2½ inches thick, with a rib at each edge and another at the center. The sections were united by strong wings standing inward and securely bolted. The ends of the arms, which were oval about 12 inches by 5 inches, were finished with a thick square flange which bolted to a corresponding flange in the middle of each section of the rim. The bolting proved to be fully as strong as the castings, as they seem generally to have broken elsewhere than at the bolts. In this case a wheel of steel constructed to resist the centrifugal force might have held until the engine could have been checked, or if it went to pieces it could scarcely have caused a more complete wreck.

A theory that is held as to the cause of the accident places the responsibility for it with the dead engineer. It is said that a couple of fuses burnt out and that during their replacement he slowed the engine by holding up the governor, and that after the fuses were replaced and normal speed was resumed they immediately burnt out again, and that he then tried to slow the engine by holding the governor *down*, with the disastrous consequences that resulted. We confess that this puts quite a strain upon our credulity, but if a man gets "rattled" there is no saying what he may not do.

Core-Making Machine and System.

We present herewith engravings of a machine designed to facilitate the making of cores for foundry use.

By the machine and the system used in connection with it only one core box of each size is used for any length of core, and the total number of core boxes required for making cores for all standard shafts from 1¼ inches to 4¼ inches is therefore only thirteen.

The complete machine and its equipment consists of the core boxes referred to; 13 iron cones for them, 13 stop-off plates for making cores shorter than the boxes; patterns for dryers for 1¼-inch cores and larger, and a ⅜ inch vent needle. An allowance of $\frac{5}{16}$ inch is made for boring, and the prints are 1¼ inches long and are tapered ¼ inch smaller at the outer ends. This is in accordance with a standard which is now quite generally adopted.

By this system all cores have a ⅝-inch square hole passing through them lengthwise; in this is placed a ⅝-inch round iron rod, leaving the four corners for vent. Any kind of chamber core can be readily made by simply pasting cores of suitable diameters and lengths onto a single rod of the required length, and such a core can thus be made without special core boxes.

In operating the machine the stop-off is first raised to the point required by the length of core to be made, and the foot treadle is then pushed down. The box is placed in position and the treadle released; this clamps the box and the apron is pulled down and the box rammed. The apron is then thrown back with the surplus sand, and, upon the treadle being again depressed, the box is released, and the core is ready to be rolled out onto the plate. The operation is rapidly performed and the results are uniform.

The machine is made by the Diamond Clamp and Flask Co., Richmond, Ind.

While investigating smokeless powders, the Government is also looking for the most noisy explosive for salutes and signals.

"Prentiss" Filers' Vise.

We present herewith an illustration of a "Prentiss" vise, designed especially for filers' use, and having specially deep jaws and a large throat opening. It is particularly adapted to bicycle manufacturers' and repairers' use. It has a wrought-steel channel section for the sliding bar, and a swivel base. It is made by the Prentiss Vise Co., 44 Barclay street, New York.

A New Lathe Tool.

Mr. E. A. Warburton, 2,207 Memphis street, Philadelphia, Pa., has invented and is manufacturing a lathe tool, the construction of which will be understood from the accompanying sketch.

There is the usual stock which has a slot milled in one end, to which is fitted a triangular piece of steel, having, of course, three cutting edges, either of which can be brought into position for use by removing the taper pin which holds the cutter in place. The screw shown serves to hold the blade in proper position, but is not an important feature of the tool except when the tool has been ground away considerably. The advantages of the tool, of course, are that forging is avoided, and that the very finest grade of steel can be used for the blade.

Death from an Emery Wheel.

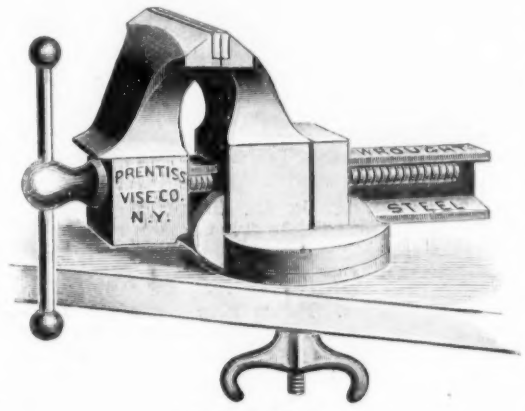
An emery wheel burst on October 8th at the printing-press factory of Robert Hoe & Company in this city, killing Robert Nobel, who was working at it. Reports seem to agree that the wheel was not running at excessive speed, but that the accident was caused by a rest that was pushed into contact with it.

Conference on Unification of Methods of Testing Materials of Construction.

Zurich, September 9–11, 1895.

The last of these conferences inaugurated by the late Prof. J. Bauschinger, and the first after his death, was the best attended of the series, and was important in the results achieved. Over three hundred members were present, and every country in Europe, except Turkey, was represented; the U. S. Army was represented by Capt. O. M. Carter, Corps of Engineers, and the American Society of Mechanical Engineers by Gus. C. Henning. It is to be regretted that other American engineering societies, engineers and railroads were not represented, as the work is of the greatest importance to all of them.

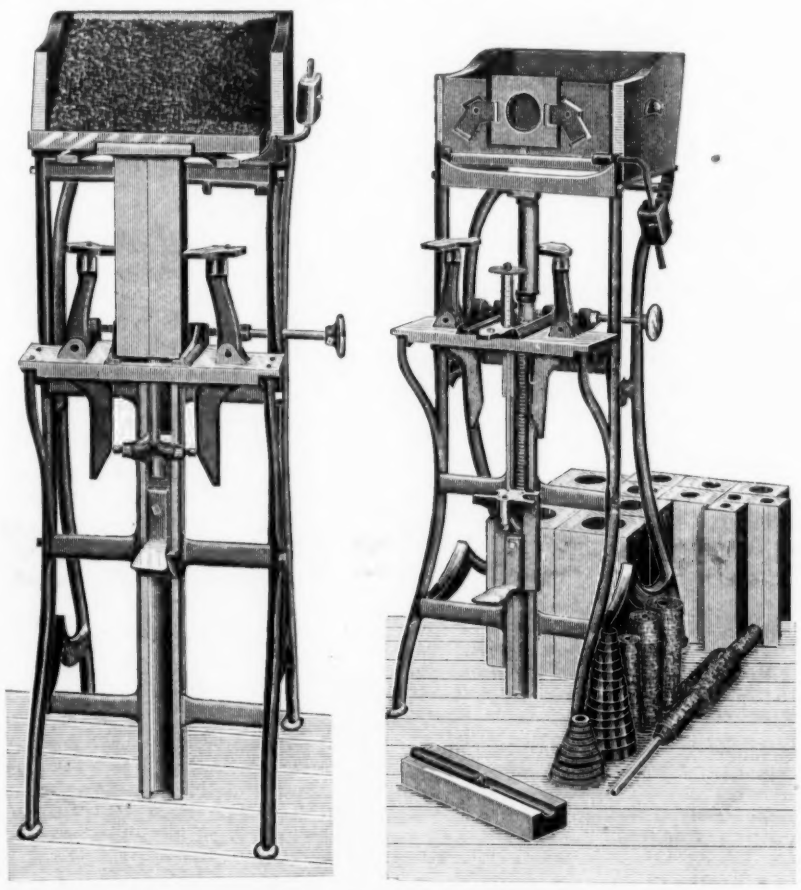
Six papers of special interest to readers of the American Machinist were presented by the chairmen of as many sub-committees, and we herewith give very short abstracts of them and the discussions had, as it would require too much space to do more than that in presenting the deliberations extending over three days.



Filers' Vise.

Prof. L. de Tetmajer is permanent chairman of the standing committee, while Dr. Exner, of Vienna, was elected as chairman for the second day, supported by Professor Benetti and M. Poloncean as honorary presidents; and Prof. C. Zschokke, chairman for the third day, supported by Mr. Gus. C. Henning and Prof. N. Belelubsky as honorary presidents.

Prof. B. Kirsch, chairman of sub-committee 13, reported on "Comparative Bending Tests of Metal, and Appropriate and Simplest Measurements and Expressions of Ductility." He described the various machines used for this test (bending by hammer being inadmissible), and discussed the measurements which are made by various observers, which are, curvature of inner, outer, and neutral axis fibre, angle over which this curvature extends, and stretch of test piece on outer surface.



Core-Making Machine.

Two questions were presented:

A. Which dimensions are to be measured, and how?

B. Which expression shall be chosen for flexibility?

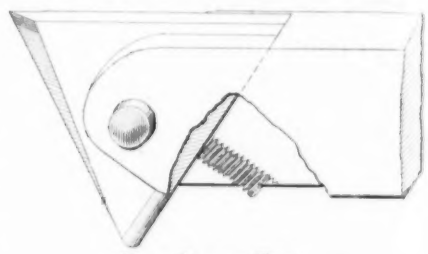
Question A. was not definitely answered; general opinion was, however, for radius of inner curvature, with angle of deflection.

Question B. was settled by adopting $\frac{s}{2r}$, or Tetmajer's formula $\frac{50\,s}{r}$ as measures of flexibility, in which s = thickness, and r = radius of curvature of neutral axis, as determined by gages.

Professor Ledebur presented report of sub-committee 14 on "Valuation of Fragility of Iron and Steel Wire produced by Immersion in Acids, and of Methods for Testing Same."

It is well known in wire works that sulphuric and muriatic acid used for removing scale produce brittleness, but that storing it for protracted periods restores ductility.

Johnson first called attention to these facts in 1875 in his paper published in "Proceedings Royal Society," Vol. XXIII., page 168. He found that not only dilutions of the above produced this effect but solution of caustic soda did likewise, while nitric acid though attacking strongly, did not so affect iron (steel). Furthermore, brittleness is largely increased when the wire is immersed in water through which a galvanic current is passed; the immersed end becomes the + pole (hydrogen), while when acting as − (oxygen) pole, it is not so affected. The iron when immersed in warm water produces foam on the surface, and bubbles of



New Lathe Tool.

hydrogen are evolved. After storing this brittle metal for some time these results disappeared. Similar observations were made by Hughes, "Journ. Soc. Tel. Engrs.," 1880, Vol. IX., page 163, and Baedecker, "Zeit. Ver. dent. Ing.," 1888, page 186; the former showed that iron (steel) alone was so affected, and that the effect was increased when the wire is put in contact with Zn., making it electro-negative—in warm acid. Professors Roberts, Austen and Ledebur demonstrated that evolution of H. was the cause of brittleness (Stahl *v.* Eisen, page 693, 1887). To determine how various kinds of iron (steel) are affected by iron, and how shape and size affected these changes of qualities, Ledebur at Freiberg, and Martens at Berlin made series of tests, which are reported in Stahl *v.* Eisen, 1887, page 681, and 1889, page 745. The results are the following: Ductility and flexibility are decreased, and in proportion as thickness decreases, and as immersion is prolonged. Even very dilute acids were found to decrease ductility by two-thirds.

Similar effects are even produced by vapors, although connection with a zinc pole prevents corrosion. Effect of chemical composition was not determined, although it was found that Si. decreases production of brittleness; high Si. cast-iron is not affected, while steel springs containing 0.75 per cent. were less affected than those containing a smaller amount. Heating to dull red, even for a very short period, removed this brittleness entirely, while storing does so only partially.

This brittleness cannot be determined by the tension test, but must be proved by bending or torsion test.

Further tests made on the plan of those mentioned are recommended.

Stone's method of testing brittleness and ductility was recommended for the above.

Prof. A. Martens, of Berlin, as chairman of sub-committee 15, reported on "Examination of Methods of Microscopical Investigations of Structure. Possibility of a Standard Method."

The essential points of this report agreed to by H. M. Howe, F. Osmond, G. Guillemin, H. Wedding, the chairman, A. Ledebur and H. Behrens, are as follows:

1. Although microphotography cannot yet be used the same as tension tests and chemical analysis, it is a valuable adjunct to them and serves to open new and valuable sources of information.

2. That the conference declares that uniform methods for making microscopical examinations are very desirable and should be established; and similarly to procure a reliable source of materials for grinding and polishing.

3. That the work of sub-committee 15 cannot be considered as concluded, but that it will rather remain a continued task for the conference; it is therefore considered advisable to ask for a continuance of the committee with increased forces. Its next task should be the publication of a report on the present state of microphotography of metals, the editing of which should be left to H. M. Howe, of Boston, Mass.

Professor Golluer, chairman of sub-committee 17, presented a report on "Methods of Testing Welds and Weldability of Iron and Steel."

The following conditions were proposed:

1. Butt welds are to be used rather than scarf or lap welds.

2. Clayey sand is to be used for wrought-iron, and powdered heavy spar for steel.

3. Proper amount of heat is to be generated as experience teaches, by use of charcoal in a blacksmith's fire.

4. The welds are to be made by machines, by application of pressure rollers, and not by hammering.

5. For welding boiler plate, 4 inches width is to be used in standard test pieces.

Methods of testing to determine the weldability of materials are to be as follows:

1. Mechanical test of resistance, to determine tenacity, elongation after rupture, reduction of area after rupture; resilience and homogeneity.

2. Bending and twisting tests to prove the perfection of weld, at least of external fibers:

(*a*) Tension tests as heretofore adopted by the conferences were to be used to determine resistance.

(*b*) Uniformity of welds, to be tested by:

(*aa*) Cold-bending test at weld, up to rupture, as defined in reports of conferences.

(*bb*) Winding test of weld while hot. Both of the latter are to be made by machines.

These propositions were not entirely agreed to, and hence it was resolved to continue the committee in order to give them more time to study the subject and to report at the next conference.

The last paper was one by E. Schroedter, representing the association of German rolling-mill men, who offered a proposition to the effect that "the conference shall search for ways and means of introducing International Standards for Quality, for Tests and for Inspection of Iron and Steel of all kinds." It did not appear that this was a matter entirely within the province of the conference, as only one part of the propositions had heretofore been considered a proper subject of consideration. It was, however, decided to turn the whole matter over to the standing committee, to report at the next meeting, which is to take place in September, 1897, at Stockholm, Sweden.

Gus. C. Henning.

If you think no good steel shows a coarse grain in the bar, what are you going to make your large dies out of?

Take, for instance, bars 5 inches, 6 inches or 8 inches square, looking quite coarse in the grain, and very often coarser toward the center of the bar than on the edges.

Don't let anyone fool you with the sight of a fine-grained piece of steel, and think it is *necessarily* very good.

It *may* be good steel, but this fine grain is readily obtained by finishing the bar cool under the hammer.

The smooth, waxy look of a freshly broken alloy steel (most self-hardened steels are alloy steels) is quite a different thing.

It is not wise to attempt the hardening of large dies or large pieces of steel in any form, unless you have suitable appliances for heating and cooling them. You had much better send them out to some one who has a good furnace for heating, and large tank with moving water for cooling large pieces. There is risk enough under any conditions. The great risk of heating large pieces in the ordinary forge fire is that some parts get hot enough to dip before others are ready, and after that some parts generally get too hot, and the results are

Tempering Dies.—Fig. 1.

disastrous. *Irregular* heating, no doubt, spoils nearly as many tools as overheating.

Any shop which has enough tool dressing to keep one or more men busy, should have a suitable furnace for heating steel, especially for hardening. Such a furnace is inexpensive, and its use will greatly improve the life and work of tools carefully heated in it, while its cost will be saved in a few months.—*Sparks From the Crescent Anvil.*

Tempering Dies.

By John Randol.

There is very often trouble in the hardening of large pieces of steel, and small pieces, too, for that matter, but as soon as a die reaches a weight of eight or ten pounds, so that it is a little beyond the ordinary toolsmith's size, there is always some anxiety about the hardening, and I think few toolsmiths plunge a die of their own making into the hardening tub without listening for the "singing" which, as the work cools, indicates a hardening crack. Hence the almost uniform success of Mr. Champney in hardening dies, as described in the American Machinist of September 26th, makes every detail of his practice worthy of

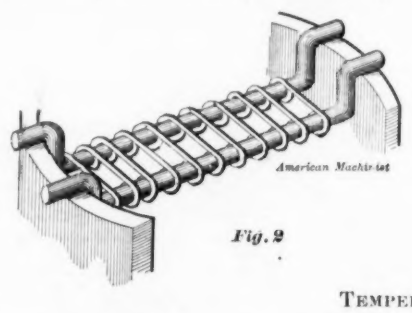


Fig. 2

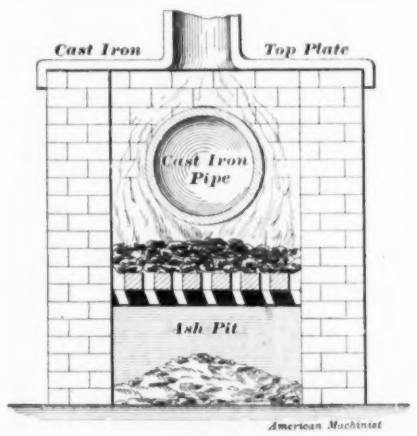


Fig. 3

Tempering Dies.

attentive consideration. It was not correct to say that Mr. Champney never cracked a die in hardening. He said in conversation, "Why, I never crack a die," and it was so written; but he afterward corrected this broad statement (too late for change in the first article), and said that he had cracked more than one die in the hardening tub, but he so seldom had trouble of this sort that, speaking in general terms, he used the words printed, and added that he never felt any uneasiness in this matter of hardening any piece whatever, either as to breakage or want of uniform hardness of surface.

Fig. 1 is from a photograph of Champney's hardening tub, which is a most inexpensive affair, and should find a place in every tool room where work of any size is to be hardened. The only use of the two overhead barrels (see Fig. 7, page 762) is to furnish a reservoir to supply the large pipe opening underneath the grating in the tub; in Champney's shop the water supply from the street main is through a very small pipe which would not supply, directly, a stream of such size as his work demands in hardening, hence the use of the overhead barrels filled by the small upright pipe shown in Fig. 1. The tub might be piped directly from the street main with a pipe of sufficient diameter to give the requisite flow, though an overhead reservoir in the shop is more certain in use, as the flow from a street main *might* fail at a critical moment.

Fig. 2 is a hand sketch of the grating on which the work is supported while cooling. The large bent rods which support the small cross wires were perhaps ⅜ inch round iron, and the cross wires were very small, perhaps No. 8 or 10 Birmingham gage. The importance of the smallness of the diameter of the cross wires is evident, as the upward flow of the water against the surface to be hardened should meet the least obstruction possible. The bottom of the grating stands, in Champney's tub, about 2 inches below the water line as determined by the overflow notch leading to the waste pipe. This is also an important feature, as the water heated by cooling the die is thus taken quickly away, instead of standing on top of the body of cold water in the tub. This general arrangement of work grating and underflow pipe is well known, and Mr. George F. Bailou informs me, was, and probably yet is, in use at the Waltham shops, and probably in many other places. There are, however, a great many tool-making establishments where it is unknown. Mr. Champney's method of hardening thick dies by cooling the bottom first until the die is hardened about half way up, is also an important detail of his practice. The effect is, of course, to first contract the bottom of the die, then, when the die is turned top side down on the grating, and the flow of hardening water enters the open cavity of the die, there is, of course, much less danger of cracking by the sudden contraction of the rim of metal which forms the thick walls of the cavity, because the thinner part has only to follow the already cooled thicker part, as the top thinner part shrinks in cooling. It is quite clear that this method of cooling the bottom of the die first is much less liable to cause a fracture than if the whole die were plunged bodily into the water; in that case the thinner parts would infallibly cool first, and would be forced to drag the thicker parts together by the shrinking of the thinner parts, which is a case of putting the weaker to overcome the stronger, and hence bad practice. The strains set up in rapidly cooling a mass of metal are very great; so great that the "hardening crack" might well be expected to be the rule rather than the exception in hardening pieces of unequal thickness, or in pieces of any form. The outer surface cools first and contracts first; this contraction is instantaneous and unavoidable, and, as the hardening of a piece of tempered steel seldom exceeds a quarter of an inch in depth, in pieces of any size, the effect is to make this thin outer shell of cooling steel compress the interior mass of the block under treatment. Viewed in this light, the formation of surface cracks in hardening dies is not at all surprising.

Mr. Gilmer Crowell, of 294 Graham street, Brooklyn, who is a very successful hardener of dies, pursues the following method: The work is heated in a cast-iron tube built into the furnace, as shown in Fig. 3. This furnace was the outcome of a long course of experiments with heating steel, to be hardened, in baths of melted metal. The familiar pot of melted lead for heating work to be hardened has the very great advantage of giving an exactly even and easily regulated temperature, but was abandoned by Mr. Crowell because of imperfections in his tempered work, which he believed due to sulphur, and perhaps other impurities, in the lead bath, which he thought were transferred to the steel in course of heating, and so injured its quality. Fig. 3 shows a section only of Crowell's heating furnace, which may be made of any length desired. The front and rear walls are pierced with openings large enough to take in a cast-iron pipe of from ½ inch to ⅝ inch in thickness, and of a diameter sufficiently great to allow the largest piece to be tempered to slide freely inside the pipe. If memory serves correctly, the furnace as seen was double, having a pipe in one division of 5 inches or 6 inches internal diameter, and in the other division a larger pipe, perhaps 8 inches or 9 inches in diameter; Mr. Crowell preferred to have the work pretty nearly fill the tube, so that the heating would proceed equally from all sides, instead of mainly from the bottom, as would be the case if the pipe were very much greater in diameter than needed to admit the work. For cooling his work, Crowell used simply a large barrel full of water into which he plunged the piece of hot steel to be hardened, nearly to the bottom, where he held it still while it cooled. Mr. Crowell gave the even and easily regulated heat obtained by use of the pipe credit for his uniform success in hardening, and also in tempering. It is no uncommon experience in tempering or "drawing" hardened work, to have a crack appear in a piece which seemed to have undergone hardening without injury, and as this never once occurred to any work which Mr. Crowell heated for "drawing" inside the hot pipe, he believed that fracture in course of the subsequent operation of tempering was due to unequal expansion produced by heating from the bottom only while drawing to color. The cast-iron pipes used by Crowell were quite durable even when used constantly, and their low cost made their occasional renewal a matter of no importance. It is well known that cast-iron at a red heat is almost perfectly transparent to gases, which pass through it when in that condition with the greatest facility; hence it may be possible that a sulphurous coal would not be safe to use for heating Crowell's form of tempering furnace; with either hard coal or common soft smith's coal the results were most satisfactory.

In a very small book, entitled "Secrets of Watchmaking," printed about thirty years ago, and sold by its author in person at $5 per copy, a method was given by which small pieces of steel can be hardened and drawn without change of color or loss of polish, by packing up the pieces to be hardened in brass filings in an iron tube having a cap screwed on each end; one cap is removed while the work is packed in brass filings in the tube, and screwed back in place before the tube is put in the fire to heat, care being taken to have the tube filled full of work and filings before closing it, so that the cap will screw down tight on the filings without leav-

ing an air space inside. The closed tube is then heated, quenched and drawn to color, as if the tube were the work itself; the work being hardened and drawn inside the tube the same as if it were treated openly, but undergoing no change of appearance whatever. Small pieces can be made extremely hard by this method, which is available for work of considerable size, and is, I believe, regularly used in some or all of the watch factories. If this belief is erroneous it will doubtless be promptly corrected by some of the readers of the AMERICAN MACHINIST.

It may not be generally known that simply drawing to color without previously hardening, hardens and stiffens some forms of steel very efficiently. A maker of those short, thin saws used in jig sawing, whose work was in great favor in Grand Rapids, Michigan, sold a very handsomely colored saw at such a low price that I said to him I should think the hardening alone was worth more than his price for the article, to which he replied by saying that his saws were not hardened at all, but were merely put in an oven after finishing and baked to straw color, and thereby made very much harder than before, and having their durability increased tenfold over that before baking. Investigation proved the correctness of the sawmaker's seemingly absurd statement; saws which before baking had hardly any elasticity, had a good spring after being baked to straw color, the temperature being raised very gradually so that the work was a long time in the oven, and the jig sawyers of Grand Rapids preferred these saws to any others.

The influence of time in tempering operations was held by many of the old-fashioned workmen to be of great importance in imparting toughness to the steel; many gunsmiths in the days of home-made rifles and shotguns believed that main springs fried for an hour in smoking hot lard in a frying pan on the kitchen stove were far less liable to break than if they were simply "blazed off" in the usual manner, and I know myself that repeated "blazings" greatly improve such low tempers as are required for screwdrivers and work of that class.

Champney, however, declares emphatically in favor of quick heating and quick drawing. It is well known that a tempered die will sometimes crack with a considerable report after it is all cold and standing by itself on the bench, greatly to the discomposure of the workman who is congratulating himself on a successful termination of his labors, and it would seem that too rapid heating and drawing might tend to this most unpleasant surprise, but Champney was decided in his statement that speed was a factor of good die tempering.

International Industrial Exhibition of the South African Republic.

Charles P. de Garno, director general of the exhibition which is to be held at Johannesburg, South Africa, informs us that the exhibition will open in April, 1896, at the Agricultural Grounds, within ten minutes of the city, and will continue for six weeks. The price of space will be ten shillings ($2.50) per square foot.

It is expected that the exhibition will afford an excellent opportunity for American builders of mining and other machinery to introduce their products in a new and very rapidly developing country, where already large amounts of American machinery have gone.

The Groaning of the Pump.

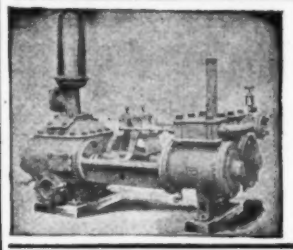
Some time ago I noticed a question (325) by J. F. B., Spokane, Washington, asking the cause of the groaning in his pump cylinder. I also read an answer by Mr. W. K. Howell, of Kansas City, Mo.

Mr. Howell suggests that J. F. B. has loose cylinder rings. Does Mr. Howell know the difference between the "click" of loose cylinder rings and the groaning or grinding noise caused by two metallic surfaces rubbing against each other, without proper lubrication?

In the same issue of the MACHINIST that contains Mr. Howell's communication, is an article entitled "The Phonograph and the Pump." I would suggest that Mr. Howell read that article and cultivate his sense of hearing until he can determine the difference between loose cylinder rings and the sound caused by friction.

As to J. F. B. and his trouble. The Keystone hotel at this place has a hydraulic passenger elevator, and the pump used to maintain the pressure is a "Duplex," size 12 inches by 7 inches by 10 inches. The pressure carried on the water tank is 100 pounds, and the pump is controlled by a Fisher pump governor.

Now we have had the same trouble with this pump. I examined all parts of the steam ends for the trouble, but did not find it. I noticed that it *only occurred during the time that the pump was doing the least duty and running the slowest.* So I came to the conclusion that the trouble was caused in the following manner: When the water pressure was standing at 100 pounds the governor never stopped the pump entirely, and it kept moving slowly all of the time, and the amount of condensation was so great that a medium or light grade of cylinder oil washed and would not keep the rubbing surfaces lubricated; then I changed and used a much heavier oil with a higher fire test, and I found that it removed the trouble



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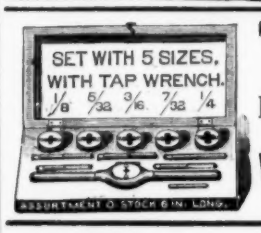

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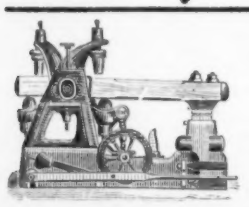

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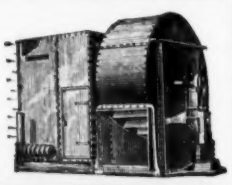

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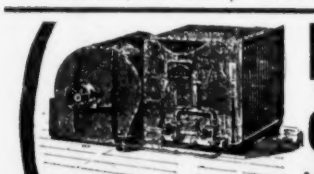

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NEW CATALOGS.

There are three sizes of Standard Catalogs, 9" × 12", 6" × 9" and 4½" × 6". We recommend the 6" × 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

We have received from the Betts Machine Co., Wilmington, Del., a pamphlet illustrating and describing their improved grinding machines of various types, the leading one of these being the machine which we illustrated and described in our columns a short time ago. The others are also machines for special purposes. The pamphlet will be sent to all who are interested on application, and is 6"x9¼", and can be readily trimmed to standard size, 6"x9".

The Diamond Machine Co., Providence, R. I., have issued a pamphlet illustrating and describing their improved grinding machines of various types, the leading one of these being the machine which we illustrated and described in our columns a short time ago. The others are also machines for special purposes. The pamphlet will be sent to all who are interested on application, and is 6"x9¼", and can be readily trimmed to standard size, 6x9.

The Jos. Dixon Crucible Co., Jersey City, N. J., issue a small pamphlet, the important feature of which is a number of letters received from practical men, engineers, machinists, etc., who have had various experiences with Dixon's pure flake graphite, as a lubricant for bearings. The pamphlet will be found interesting and valuable to those who have to do with machinery, and is sent to any address on application. It is 5⅜"x6⅞".

The Gibbs Electric Co., Milwaukee, Wis., send us a pamphlet illustrating and describing the various forms of electric motors made by them, and which are intended for a variety of service. We note that the first of these, "Type A.," is designed to be used either as a motor or dynamo. These motors are extensively used in industrial establishments, and the catalog is sent to those interested upon application. It is standard size, 6"x9".

The Whiting Foundry Equipment Co., 1522 Monadnock Block, Chicago, Ill., send us an illustrated catalog which is devoted exclusively to the various forms of cranes and other hoisting and conveying apparatus made by them, and especially adapted to foundry use. Every foundryman will find things of interest and value to him in this catalog. It is standard size, 6"x9", and is sent to those interested on application.

The Ingersoll-Sergeant Drill Co., Havemeyer Building, New York, have issued "Catalog No. 40," which is a large and fine publication of its class, setting forth fully the points connected with the line of machinery built by them, which includes rock drills, air compressors, and a large variety of machinery and appliances used in quarrying, mining and similar operations. Though the catalog is a large and expensive one evidently, the company inform us that they will send a copy to anyone on application. It is 8⅛"x10½".

The Robb Engineering Co., Amherst, N. S., have issued a new catalog illustrating and describing their well-known Robb-Armstrong engine, which has been the subject of an illustrated article in our columns, and is classed among the high grade, automatic engines. The catalog is well illustrated, and will be found of interest to all who are concerned with matters of power generation. It is sent to those interested on application, and is 5¾" x9¼". It could as well have been standard size, 6"x9", and possibly was intended to be so.

We have received from the Jones & Lamson Machine Co., Springfield, Vt., a copy of the fifth edition of their catalog, entitled "Rapid Lathe Work." The mechanical execution of this fifth edition is even finer than the previous editions, which, as many of our readers know, is saying a good deal. It is a most elegant thing in both illustration and text, and tells about all a shop manager may wish to know regarding the Hartness flat turret lathe short of the knowledge to be gained by its actual use in his shop. It is sent to those interested on application, and is standard size, 6"x9".

The Correspondence School of Technology, Cleveland, Ohio, sends us a catalog, outlining the work done by that institution in the education of those who for some reason are not able to attend the regular schools, and who wish to pursue studies in the various technical branches. The branches taught are Electrical Engineering, Steam Engineering, Bridges, Roofs and Iron Structures, Surveying and Road Construction, Mechanical Engineering, Hydraulic Engineering and Advanced Mathematics. The catalog is sent to those interested on application, and is standard size, 6"x9".

MANUFACTURES.

The Buescher Mfg. Co., of Elkhart, Ind., which was recently destroyed by fire, will shortly be rebuilt.

The Acme Coupler Co., of St. Louis, Mo., has recently been incorporated by J. G. Chouteau and Louis Hinsman.

The Baltimore (Md.) Malleable Iron & Steel Casting Co. has commenced work on its new building, which is to be 40x210 feet.

The Empire Manufacturing Co., of Portland, Me., has been formed, with $100,000 capital, by George E. Hogan and Jno. G. Cummings.

Frank Hickok and others have incorporated the Hickok Lumber Co., at Ogamaw, Ark., to operate saw-mills, with a capital stock of $50,000.

The Shickle, Harrison & Howard Iron Co., of St. Louis, Mo., will shortly erect a new steel foundry and cast-iron pipe plant. A large machine shop will also be built to the works.

The Empire Metal Wool Company, of New York City, has been incorporated to manufacture metals and metal goods, with a capital of $30,000, by Alfred Haven and Sigmund Feust, of New York City, and Henry Ganz, of Orange, N. J.

The Wilson-Bates Electric Company, of New York City, has been organized to manufacture telephones and all kinds of electrical or magnetic machinery, with a capital of $1,500, by Wm. C. Wilson, George B. Bates and Henry G. Issertel, of New York City.

The New York Fare-Register and Supplies Company, of New York City, has been organized to manufacture fare registers for passenger cars, with a capital of $50,000, by Andrew H. Hogg and James Brady, of Brooklyn, and William K. Jewitt, of New Brighton, S. I.

Mr. John Platt, 97-103 Cedar street, New York, has been appointed representative in the United States of Messrs. John I. Thornycroft & Co., of Cheswick, England, and will attend to matters connected with the introduction of the well-known Thornycroft boilers in this country.

The Berlin Iron Bridge Co., of East Berlin, Conn., have just completed a new store room for the Hartford Rubber Works, a new car house for the Norwalk Tramway Co., at South Norwalk, Conn., and also a new generator house for the Burlington Gas Light Co., at Burlington, Vt. They report work as very brisk in all departments.

Messrs. A. L. Ide & Son, Springfield, Ill., builders of the Ideal steam engine, are sending out packs of playing cards of fine quality, upon receipt of 10 cents in postage stamps. Cards of equal quality sell at a considerably higher price in the stores. On the backs of these cards—instead of a meaningless design—are fine half-tone engravings of various styles of the Ideal engine.

The Fred J. Meyers Co., of Hamilton, Ohio, extensive manufacturers of wire goods, are making an addition to their plant for the purpose of manufacturing bicycles. They will turn out from four to five thousand wheels per year. They will use a patent tire on their wheel which promises to be a success. They expect to be in operation by the 1st of November. They have placed their order with the Lodge & Davis Machine Tool Co., of Cincinnati, Ohio, for their hub machines, screw machines, milling machines, and other bicycle tools.

Mr. E. G. Hoffmann, who will be remembered as the inventor and designer of a very remarkable ball-bearing caster made of sheet steel, which we illustrated in our paper some time ago, and also of a, possibly, still more remarkable machine for making steel balls, has organized the Hoffmann Machine Co., which will equip shops at Amsterdam avenue and 143d street, New York City. In this shop the new company will construct a large number of Mr. Hoffmann's special screw machines, and will go very largely into the manufacture of steel balls, and other articles adapted to be manufactured on this machine, such as chain pins and other screw machine work, particularly that which requires to be finished on both ends.

Recent sales of the "Ideal" engine have been made as follows: City of Harvard, Ill., one 9x10. City of Paris, Ill., one 15x14. Penitentiary at Phoenix, Ariz., and Yuma, Ariz., two 8x10. Williams, Davis, Brooks & Co., Detroit, one 12x12. City of Astoria, Ill., one 13x12. Samuel Cupples Real Estate Co., St. Louis, one 10 and 16x12. Reisch Bros. Brewery, Springfield, Ill., one 8x10. Anheuser-Busch Brewery, St. Louis, one 10 and 16x12. C. L. Kellogg, Oconomowoc, Wis., one 5x6. Hunter, Glen & Hunter, Detroit, one 11x12. E. Tosetti Brewing Co., Chicago, one 8x10. Village of Aitkin, Minn., one 13x12. Illinois Zinc Co., Peru, Ill., one 8x10. Machinery Supply Co., Los Angeles, Cal., one 13x14. Village of Cloquet, Minn., one 8x10. A. W. Sullivan, Gen. Supt. Ill. Central R. R., Chicago, one 10x10. Feldhauser Building, Denver, one 12x12 and one 9x10. Mack Building, Denver, two 11x12. Tecumseh Electric Light Co., Tecumseh, Mich., one 10 and 16x12.

Machinists' Supplies and Iron.

NEW YORK, October 12, 1895.

Iron—American Pig—We quote standard Northern brands, $14 to $14.50 for No. 1; $13 to $13.50 for No. 2; $12.75 to $13.25 for No. 2 Plain, and $12.50 to $13 for Gray Forge. Southern brands, $14 for No. 1; $13.50 to $13.75 for No. 2; $13 to $13.50 for No. 3; $13.50 to $14 for No. 1 soft; $13 to $13.50 for No. 2 soft; and $12.50 to $12.75 for Foundry No. 4.

Antimony—The market is quiet. Cookson's is quoted at 8c. to 8¼c.; Hallett's at 7¼c., and Japanese at 6¾c.

Lard Oil—Prime City is quoted at 50c. to 51c.

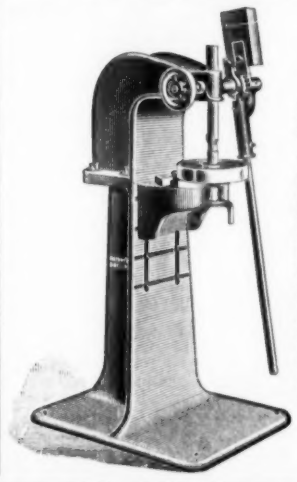
Copper—The market shows signs of improvement. Lake Copper has been sold at 12c., and for small lots 12¼c. has been realized. Casting Copper is held at 11¾c. to 11⅞c.

Lead—The market is firm. Common Domestic has been sold at 3.35c. Sellers are now holding out for 3.37½c. to 3.40c.

Spelter—The market is dull and weak. Good brands are quoted at 4.30c. to 4.25c., New York delivery.

Tin—The market has a firm tone, but business is light. For early deliveries 14.60c. to 14.65c. is asked.

The Greenerd Arbor Press.



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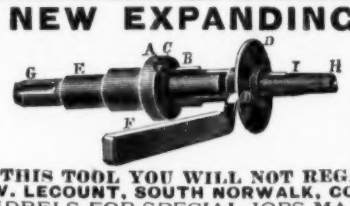
Taking anything from ⅛ to 1 inch inclusive.
Price.....$5.00
Patented Dec. 25, 1877.

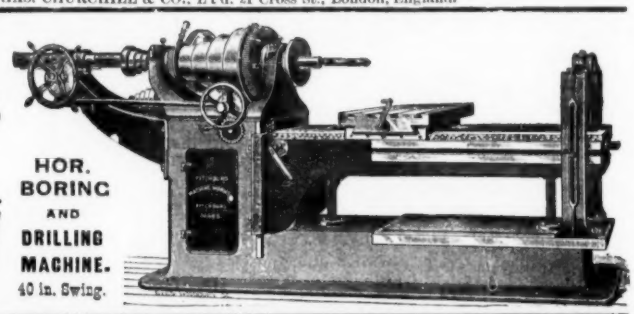


Machinist's Size.

No.			PRICE.
1	⅛ to 1	in.	$10
2	1 "	1½ "	14
3	1½ "	2 "	18
4 (with screws)	2 "	3 "	32
5 " "	3 "	4 "	44

IF YOU WILL TRY THIS TOOL YOU WILL NOT REGRET THE EXPENSE.
C. W. LECOUNT, SOUTH NORWALK, CONN.
SPECIAL MANDRELS FOR SPECIAL JOBS MADE TO ORDER.
These goods are for sale by CHAS. CHURCHILL & CO., L'td. 21 Cross St., London, England.

FITCHBURG MACHINE WORKS,
FITCHBURG, MASS., U. S. A.
LATHES, DRILLS, PLANERS.
SPECIAL MACHINERY
DESIGNED and BUILT TO ORDER.
CATALOG E.



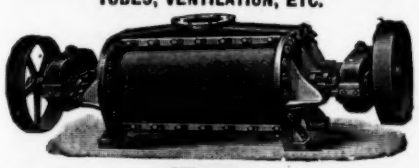
HOR. BORING AND DRILLING MACHINE.
40 in. Swing.

BUILDERS IRON FOUNDRY,
FOUNDERS AND MACHINISTS,
PROVIDENCE, R. I.
We can guarantee that our castings will be uniform and of high tensile strength.
Tensile strength of ten specimens taken from an air furnace heat:

34,260 lbs.	34,390 lbs.	32,600 lbs.	33,200 lbs.	34,400 lbs.
36,420 "	34,650 "	32,460 "	36,550 "	36,700 "

DON'T ACCEPT ANY SUBSTITUTE FILE.
INSIST ON HAVING NICHOLSON
NICHOLSON FILE CO.
PROVIDENCE, R. I., U. S. A.
3000 VARIETIES FILES
(X. F.) & INCREMENT CUT FILES.

ROOT'S FORCE BLAST ROTARY BLOWER.
For FOUNDRIES, SMITH SHOPS, PNEUMATIC TUBES, VENTILATION, ETC.



SLOW SPEED, POSITIVE BLAST, PERFECTLY BALANCED.

BEST MECHANICAL CONSTRUCTION.

P. H. & F. M. ROOTS, Manufacturers,
CONNERSVILLE, IND.
Chicago Office: 1405-10 Manhattan Building.
COOKE & CO., Selling Agents,
163 & 165 Washington St., NEW YORK.
In Writing Please Mention This Paper.

HENRY CAREY BAIRD & CO.,
INDUSTRIAL PUBLISHERS, BOOKSELLERS AND IMPORTERS,
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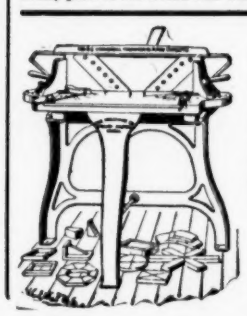
Our New and Revised Catalogue of Practical and Scientific Books, 88 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.



THE NEW FOX Universal Trimmer
is the only one that has an accurate adjustment of the gauges. Cannot be set wrong. Work must be correct. Time saved in Pattern-making and all wood-working.
CATALOGUE FREE!
FOX MACHINE CO.,
325 Nor. Front St., Grand Rapids, Mich.
135 Finsbury Pavement, London, England.

FOR SALE.

A Large Manufacturing Plant lately used as a Bicycle Works. Large part of Shafting and Pulleys already in position, so that Machinery could be attached and operations begun at once. This property, with water power, is well adapted to many kinds of manufacturing purposes, and will be sold cheap. For further information address, JAS. DICKSON, 98 4th St., Pittsburg, Pa.

JESSOP'S STEEL
FOR TOOLS, DRILLS, DIES, &c.
ALL KINDS IN STOCK.
Manufactory, SHEFFIELD, ENG.
Chief Am. Office, 91 JOHN ST., N. Y.
WM. JESSOP & SONS, LTD.
Established a century ago.
Medal World's Columbian Exposition 1893.

WORTHINGTON STEAM PUMPS
FOR ALL DUTIES.

HENRY R. WORTHINGTON,
NEW YORK, 86 and 88 Liberty St. BOSTON, 70 Kilby St. PHILADELPHIA, 607 Arch St. CLEVELAND, 24 South Water St. CHICAGO, 185 to 189 Van Buren St. ST. LOUIS, Eighth and St. Charles Sts. INDIANAPOLIS, 64 South Pennsylvania St. DETROIT, 155 Jefferson Ave.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS.

On and after July 4th this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Wanted—Bright, active machinists to canvass for subscription to AMERICAN MACHINIST, liberal commission. Address, with refs., Subscription Dep't, AMERICAN MACHINIST, 203 Broadway, N. Y.

Situation wanted by patternmaker. Address B., care AMERICAN MACHINIST.

Draftsman with shop and office experience and technical education wants pos. O. M., AM. MACH.

Draftsman, mechanical, general machinery and pumps; A1 refs. Box 139, AMERICAN MACHINIST.

Wanted—A 1st class gen'l mach., accustom'd to light job'ng work. J. Erlandsen, 172 Center St., N. Y.

A graduate of technical school wants position in mechanical or electrical engineering; not afraid of work. Address Box 5, Bluff Springs, Illinois.

Wanted—Draftsman, with experience on freight and passenger car work; state age, experience, and salary expected. Box 143, AM. MACHINIST.

Millwright and patternmaker, accustomed to general mill repairs; competent as foreman; A1 references. X. Y. Z., AMERICAN MACHINIST.

A good, live machinist that is capable of handling help in a small shop running about 10 to 15 men, doing repair and special work. Box 136, AM. MACH.

Wanted—Good draftsman, one exp'd in automatic screw mach'y pref'd; permanent pos'n for reliable and steady man. 605 West 36th St., City.

First-class engineer and machinist wants to take charge of motive power and repair departments in large factory; 12 years' experience. Mechanic, AMERICAN MACHINIST.

Wanted—By a first class machinist and draftsman, a position as foreman. Have held such positions, and can give the best of references. Address BOX 137, AMERICAN MACHINIST.

Machinists Wanted—First-class vise, planer and boring-mill men wanted by concern mfg. heavy engines and machinery; good Ohio town; no intemperates nor incompetents need apply. Address stating exp., BOX 140, AMERICAN MACHINIST.

Wanted—An experienced and competent salesman, familiar with the twist drill trade; applicants with engineering knowledge will be given preference; mention experience, references, and salary expected. Address Drills, AMERICAN MACHINIST.

Wanted—Thoroughly experienced man for automatic wire-heading machines; must be able to make his own dies and repairs, and produce the

(*Continued on Page* 815.)

CLEVELAND TWIST DRILL CO.'S GRIP SOCKETS.

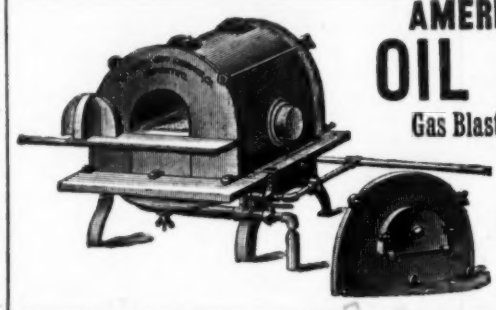
No More Twisted Tangs.

Larger drills can be used with smaller shanks than ever before.

No charge for the groove in the shanks.

Send for Descriptive Price List.

Cor. Lake and Kirtland Sts., Cleveland, Ohio.



AMERICAN GAS FURNACE CO.,

OIL GAS PLANTS

Gas Blast Furnaces & High Pressure Blowers

For the economical generation and systematic application of HEAT.

CATALOGUES ON APPLICATION.

No. 80 Nassau St., - NEW YORK.

ENGLISH AGENCY:
Chas. Churchill & Co., Ltd., 21 Cross Street, Finsbury, London, E. C., England.

SECOND-HAND MACHINERY.

1 1500 Ton Hydraulic Press, Platen 42 in. x 42 in.
1 60 Ton Watson & Stillman Broaching Press.
1 No. 60 Bliss Double Action Drawing Press.
1 No. 50 Jones Presses (Equivalent to No. 20 Bliss).
1 No. 1 Bliss Reducing Press, Back Geared with 8 in. stroke.
1 86 in. x 20 ft., Lincoln Triple Geared Engine Lathe.
1 84 x 21 ft., Wilmarth " " " "
1 54-61 in. x 22 ft., New Haven Triple Geared (Good as new).
1 30 in. x 10 ft., Fifield Engine Lathe, Compound Rest, P. C. Feed.
1 29 in. x 10 ft., Perkins " " " "
1 each 26 in. x 12 & 17 ft., D. W. Pond Lathe, Compd. Rest, "
1 26 in. x 12 ft., New Haven Lathe " "
1 24 in. x 10 ft., Pratt & Whitney Lathe, " "
1 16 in. x 10 ft., Bullard Lathe, Plain Gib Rest.
1 15 in. x 6 ft., Prentice Bros. Lathe, Raise and Fall Rest.
1 15 in. x 6 ft., Flather Lathe, Plain Gib Rest and P. C. Feed.
1 14 in. x 6 ft., Reed Lathe, " "
20 Speed Lathes (Assorted Sizes).
1 60 in. x 60 in. x 26 ft., L. W. Pond Iron Planer.
1 36 in. x 36 in. x 10 ft., D. W. Pond Iron Planer.
1 32 in. x 32 in. x 10 ft., " " 2 Heads.
3 24 in. x 24 in. x 6 and 7 ft., Iron Planers.
1 16 in. x 16 in. x 15 in. Blaisdell Crank Planer.
1 36 in. New Haven Drill, Back Geared and P. Feed.
1 30 in. Prentice " " "
1 28 in. Barnes " " "
1 Style "B" Bickford Radial (Full Universal).
1 No. 2 Brainard Back Geared Miller.
1 No. 4 Garvin " " "
1 7 Brainard Back Geared Lincoln Pattern Miller.
1 No. 3 Brown & Sharpe Universal Miller.
1 60 in. Pond Boring and Turning Mill (2 Heads).

700 Machine Tools in Stock. Send for Lists. Bicycle Catalog Just Out.

PRENTISS TOOL AND SUPPLY CO.
115 LIBERTY STREET, N. Y.
Chicago Store: 62 & 64 So. Canal St.

SECOND-HAND MACHINE TOOLS.

ENGINE LATHES.
Fifield Improved Lathe, 25 x 12 Compound Rest.
15 x 6 Blaisdell, Compound Rest with turret; Hollow Spindle.
14 x 6 Robbins Compound Rest, Hollow Spindle, Power Cross Feed.
13 x 6 Ames Rise and Fall Rest, Hollow Spindle.
11 x 4 Manu, Hollow Spindle.
16 x 7 Maker Unknown.
16 x 8 Blaisdell, Plain Rest.
18 x 10 Flather's, Plain Rest, Large Hollow Spindle.
18 x 10 Blaisdell, Plain Rest.
28 x 20 Perkins Power Cross Feed.
37 x 14 Maker Unknown.

PLANERS.
16 in. x 16 in. x 4 ft. Hendey.
20 in. x 20 in. x 4 ft. Nashua.
22 in. x 22 in. x 4 ft. L. W. Pond.

SHAPERS.
10 in. Juengst, Crank.
12 in. Juengst, Crank.
10 in. Wood and Light, Traverse Head.
18 in. Putnam, Traverse Head.
15 in. Juengst Friction Shaper.

DRILL PRESSES.
6 Spindle Quint, Turret.
No. 2 Three Spindle, Garvin.
No. 2 Four Spindle, Pratt & W.
No. 4 Four Spindle, Garvin.
20 in. Snyder, Back Geared.
24 in. Blaisdell, Wheel Feed.
24 in. Aurora, Back Geared.
30 in. Pond, Back Geared, Power Feed.
9 ft. Holly Mfg. Co., Radial.

SCREW MACHINES.
No. 00 Garvin, Wire Feed.
No. 5 Brown & Sharpe.
No. 1 Garvin, Plain.
No. 2 Garvin, Plain.
16 in. x 5 ft. Reed Chucking Lathe.

MILLING MACHINES.
4 No. 2 Pratt & Whitney Lincoln.
1 No. 20 Garvin, with arm.
1 No. 2 Garvin Plain.
No. 0 Garvin Universal.
No. 1 Garvin Universal.
No. 2 Garvin Duplex.
No. 1 Garvin Hand.
No. 2 Garvin Hand.
No. 4 Brainard, with 10 in. Garvin Dividing Head.
1 Putnam-Lincoln Miller.

Also, a large list of other machines. Write for complete list detailed description and prices.

THE GARVIN MACHINE CO.,
LAIGHT & CANAL STS., NEW YORK.
Also, 51 North 7th St., Philadelphia, Pa.

Second-Hand Machinery

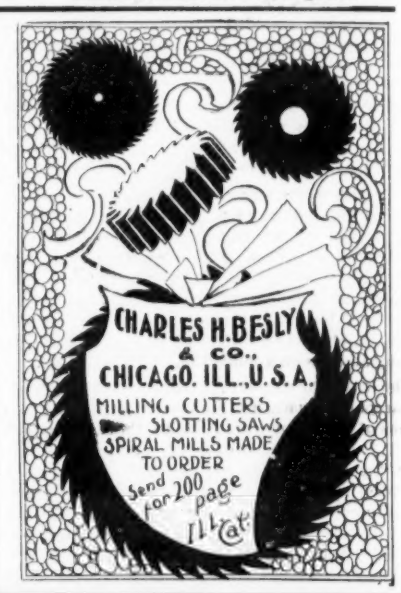
in first-class order, much of it as good as new.

We have constantly in stock a large selection of such machinery, bought for cash or taken in trade for new tools.

It sells so quickly that it doesn't pay to print a list, but we **may** have the **very machine** you need.

Please tell us what you want. If we have it we'll make the **price right.**

HILL, CLARKE & CO.,
Machinery Merchants,
156 Oliver St. BOSTON. 12 S. Canal St. CHICAGO, Ill.



MACHINE TOOLS.

IN FIRST-CLASS CONDITION.

16 in. F. B. Miles Slotting Machine.
2,400 Pound Miles Steam Hammer, Single Standard.
30 in. by 27 ft. Pratt & Whitney Engine Lathe.
Horizontal or Floor Boring Machine, Pratt & Whitney.
Two (2) 5 ft. Universal Radial Drills.
21 in. x 11 ft. Pratt & Whitney Engine Lathe, Hollow Spindle.
19 in. x 8 ft. Pratt & Whitney Engine Lathe, Hollow Spindle.
26 in. x 8 ft. Pond Machine Tool Co. Engine Lathe.
19 in. x 12 ft. Pratt & Whitney Engine Lathe, Hollow Spindle.
22 in. x 12 ft. Pratt & Whitney Engine Lathe, Hollow Spindle.
40 in. Bement Vertical Drilling Machine.
24 in. Pratt & Whitney Vertical Drilling Machine.

GEORGE PLACE MACHINE CO.,
145 Broadway & 86 Liberty St., New York.

MACHINERY BARGAINS

BEFORE REMOVAL.

At Phœnix Iron Works, Trenton, N. J.

15 in. x 6 ft. Engine Lathe.
22 " x 12 " " "
29 " x 13½ " " "
26 " x 20 " " "
37 " x 30 " " "
71 " x 18 " " "
52 in. x 20 ft. Engine Lathe.

19-36 and 50 in. Drills.
Portable Drill.
36 in. x 14 ft. Planer.
12 in. Shaper Traverse Head.
Gear Cutter, 54 in.
Milling Machine.

10 ft.-16 ft. Vertical Boring and Turning Mill, Cranes, Blower, Boiler Rolls, Punch and Shear, etc.

Send for full list and prices.

GEORGE PLACE MACHINE CO.
145 Broadway and 86 Liberty St.,
NEW YORK.

A FEW RARE BARGAINS.

60" Pond Boring Mill, with 2 heads.
84"-Swing Engine Lathe, bed 20 ft. long.
18" x 10 ft. Flather Engine Lathe.
15" x 6 ft. Flather Engine Lathe.
30" x 30" x 8 ft. Whitcomb Planer.
26" x 24" x 7 ft. Wheeler Planer.
Send for complete new list just out.

HILL, CLARKE & CO.,
156 Oliver St. BOSTON. 14 S. Canal St. CHICAGO.

SECOND-HAND MACHINERY.

36" Gould & Eberhardt Gear Cutter.
26" Pratt & Whitney Chucking Lathe.
60" Triple-geared New Haven Lathe, with chuck jaws.
40" New Haven Back-geared and Power-feed Drill.
32" Double-head Pond Planer.
No. 1 Giant Key Seater.
Send for complete list. Send for catalogue of Bicycle machinery.

PRENTISS TOOL AND SUPPLY CO.,
62 & 64 S. CANAL ST., CHICAGO, ILL.

PUMP FOR SALE.

One New Delamater Duplex Steam Pump, 8 x 5 x 10, brass-lined, 4" suction, 3" discharge; a bargain. Other sizes, new and second-hand. **COOKE & CO., 163 & 165 Washington St., N. Y.**

FOR SALE BY THE
WESTERN ELECTRIC CO., CHICAGO.

4 Pratt & Whitney No. 1 six-spindle drills with screw attachment for elevating table and doors, for covering spindles at $175 each.
3 Pratt & Whitney four-spindle drills with screw attachment for elevating table and doors, for covering spindles, at $125 each.
1 Pratt & Whitney three-spindle drill with doors for covering spindles, at $100.

Second-Hand Machinery.

LATHES.
2 30 in. x 5 ft. Foot & Power.
2 11 in. x 5 ft. Power only.
1 15 in. x 6 ft. Dustin.
1 16 in. x 8 ft. Flather.
2 18 in. x 8 ft. Flather & Prentice.
3 18 in. x 8 ft. Lodge & Davis.
3 21 in. x 10 ft. Pratt & Whitney.
1 27 in. x 10 ft Dustin.
1 28 in. x 12 ft. Blaisdell.
2 30 in. x 14 ft. Lincoln.
1 32 in. x 13 ft. Bement Triple Geared.
1 22 in. x 10 ft. Niles.
1 24 in. x 10 ft. Niles.
1 79 in. Driving Wheel, Bement.
1 48 in. x 18 ft. Gay & Silver.

PLANERS.
3 48 in. x 32 in. x 6 ft. Pond, two heads.
1 48 in. x 32 in. x 8 ft. Pond, two heads.
3 24 in. x 24 in. x 6 ft. W & L., one head.
1 28 in. x 28 in. x 8 ft. Gay & Silver.
1 32 in. x 32 in. x 10 ft. W. & L.
1 38 in. x 38 in. x 10 ft. Aldrich.

DRILLS.
1 32 in. x 10 ft. Open Side.
1 60 in. x 60 in. x 22 ft. Hepworth.
3 22 in. Back Geared.
2 25 in. " & P. F., Snyder.
1 34 in " " Harris.
3 No. 1½ Niles Radial.
2 Suspension Drills.

MILLING MACHINES.
1 No. 1 B. & Sharpe.
2 No. 13 Garvin.
1 No. 15 "
1 No. 2 " Hand, and others.

SHAPERS.
9 in., 12 in., 13 in., 15 in., 20 in.

MISCELLANEOUS.
1 18 in. P. & W. Screw Machine.
1 20 in. x 6 ft. Flather "
2 Horiz. B. & D. Machines.
1 Cylinder Borer, P. & A.
1 36 in. Motor Gear Lathe.
1 Double Punch and Shear.
1 30 in. Pulley Lathe.
1 Hydraulic Riveter.
2 Bolt Cutters.
1 Nut Tapper.
1 20 in. Pattern Lathe.

Also large stock of other tools. Send for List.

Eastern Branch Niles Tool Works Co.,
136 and 138 Liberty St., NEW YORK CITY.

SECOND-HAND TOOLS.

MODERN STYLE. FIRST-CLASS ORDER.
Will Be Sold Very Low Before Removal.

ENGINE LATHE—Flather, 14 x 6 ft., Hollow Spindle, Cross Feed.
" " Blaisdell, 16 x 6 ft., Raise and Fall Rest.
" " Pratt & Whitney, 16 x 7 ft., Raise and Fall Rest.
" " Putnam, 16 x 8 ft., Raise and Fall Rest.
" " Flather, 18 x 8 ft., Hollow Spindle, Cross Feed.
" " Pond, 20 in. x 15 ft., Extra Heavy, A 1.
" " Harrington, 20x10 ft., Compound Rest, Cross Feed.
" " Fay & Scott, 36x18 ft., Compound Rest, Cross Feed.
" " Pratt & Whitney, 42 in x 10 ft., Triple Geared, complete, A 1.
" " Hewes & Phillips, 60 in. x 20 ft., Triple Geared, Compound Rest, etc. A 1.
" " Union, 72 x 20 ft., Triple Geared, Screw Feed.
PLANER—Pease, 22 x 5 ft., Heavy Pattern.
" Hendey, 22 x 5 ft., Friction. A 1.
" Gould & Eberhardt, 26 in. x 8 ft. A 1.
" Fitchburg, 27 x 8 ft., Automatic Feeds.
" Pond, 32 in. x 8 ft.
" Pond, 36 x 12 ft. A 1 order.
" Betts 36 x 10 ft., Extra Heavy.
" Gray, 48 x 12 ft., "Latest," 2 Heads.
" Betts, 60 x 16 ft., 4 Heads, Extra Heavy, A 1.
" Crank 12 in. stroke, "Pond's."
SHAPER—Gould & Eberhardt 15 in. Crank.
" Prentiss 17 in. Crank. Good as new.
" Hendey 24 in. Friction. Good order
" Pratt & Whitney 14 in. x 60 in., Traveling Head, 2 Tables.
" Fitchburg 14 in. Traveling Head, 28 in. Feed.
DRILL—Prentice 26 in., Friction Pulleys for tapping.
" Blaisdell 28 in., Back Gears.
" Hamilton 28 in., Back Gears, Automatic Feed.
" Pond 32 in. Extra Heavy, Back Gears, Automatic Feed.
MILLING MACHINE—Pratt & Whitney No. 2 Hand Feed and Vise.
" " Garvin No. 3, Power Feed, Vise, etc.
" " Kempsmith Universal Miller.
" " Lincoln Pattern with Vise.
PROFILING MACHINE—Pratt & Whitney, 2 Spindles, Forming Attachment, A 1.
SCREW MACHINE—Bardons & Oliver No. 2 Screw Mach., Wire Feed
" " Jones & Lamson, 2 in. Hole Friction Back Gears, Chasing Bar and Turret Feed complete with Tools, A 1 order.
" " Niles, 2 in. hole, Carriage Feed with Tools.
GEAR CUTTER—Gould & Eberhardt, 2 in. Automatic.
" " Gould & Eberhardt, 30 in. Automatic.
" " Gould & Eberhardt, 36 in. Automatic.
" " Hewes & Phillips, 60 in. Semi-Automatic.
PRESSES—Bliss No. 18 and 19.
" Stiles No. 1, 2 and 3.
Horizontal Boring and Drilling Machine Sellers 60 in.
Upright Boring and Turning Mill, 38 in. 2 Heads, A 1.
Steam Hammer 300 lb., Ferris & Miles.
Boiler Punch, 24 in. Gap, Standard Size.
Boiler Rolls, 10 ft., Improved Style, A 1.
" " 8 ft., Extra Heavy.
" " 7 ft., Hilles & Jones, A 1.
" " 6 ft., Extra Heavy.

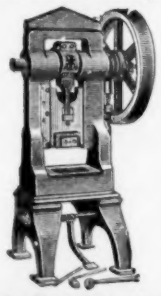
BICYCLE MACHINERY

CONSISTING OF SCREW MACHINES, MILLING MACHINES, DRILLS, LATHES, PRESSES, SHAPERS, Etc.

J. J. McCABE,
SUCCESSOR TO E. P. BULLARD'S N. Y. Mach'y Warerooms.
14 Dey St., NEW YORK.

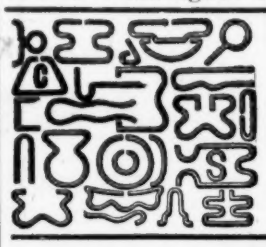
E. W. BLISS CO.
1 ADAMS ST., BROOKLYN, N. Y.
Chicago Office, 96 W. Washington Street.

Machinery for Bicycle Parts and Fittings, Armature Rings, Etc. Drop Presses and Shears.



BLISS TOGGLE DRAWING PRESS, fitted with the BEST FRICTION CLUTCH ON THE MARKET.

STILES & PARKER PRESS CO.



BLAKE & JOHNSON, Waterbury, Conn.

BUILDERS OF

PIN, SAFETY PIN, HOOK AND EYE MACHINERY,

AND LABOR-SAVING MACHINES OF EVERY DESCRIPTION.

Bent Wire Goods a Specialty. Send Samples that we may quote prices for either machine or the Goods.

STEEL BALLS

For all Anti-Friction Purposes.

WE ALSO MANUFACTURE

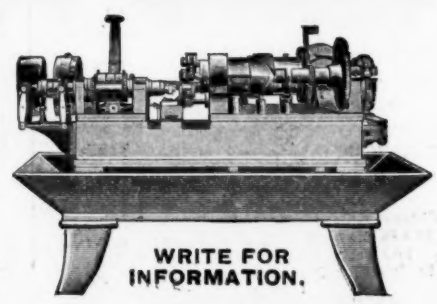
AUTOMATIC SCREW MACHINES

AND

SCREW MACHINE PRODUCT

OF EVERY DESCRIPTION.

Cleveland Machine Screw Co.,
CLEVELAND, OHIO.



WRITE FOR INFORMATION.

best work in a rapid manner. Apply at Standard Caster & Wheel Co., 605 West 36th street, City.

Wanted—Superintendent for small machine shop in Chicago, who is a good draftsman and experienced in engine and general work; state experience and salary expected. Address Van Buren, care of AMERICAN MACHINIST.

Am looking for a change of employment to Phila., New York or vicinities; 25 years' constant experience in all branches of machine work; exceptional references, and if conditions favor can bring work. Address J. J., AMERICAN MACHINIST.

Wanted—One or two first-class draftsmen, capable of designing tools and fixtures, and familiar with gun, sewing machine, bicycle and typewriter work; also a few competent die sinkers. F. C. S., Box 141, care AMERICAN MACHINIST.

Wanted—A position as assistant draftsman department foreman, or where advancement is probable, by a well educated all-around machinist, familiar with steam engines, electric motors and turret machinery; Mass. or Conn. preferred. Address Box 142, AMERICAN MACHINIST.

Wanted—Situation as superintendent or foreman in or near New York City by a 1st-class practical mechanic, experienced on die and tool work for sheet metal, and building of light or heavy automatic machinery; bicycle, electrical, or experimental work. Address L. D., AM. MACHINIST.

Wanted--An intelligent man in every machine shop in New England to utilize his spare time in raising clubs of subscribers for the AMERICAN MACHINIST; liberal commission. Address, with references, John A. Walker, N. E. Agent, No. 4 Church Street, Dorchester, Mass.

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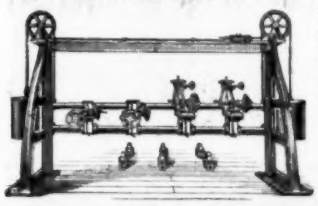

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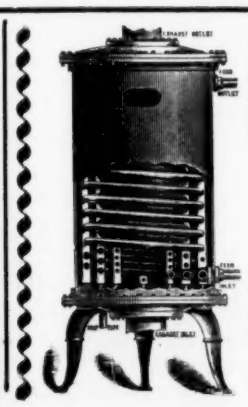

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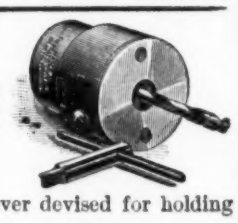

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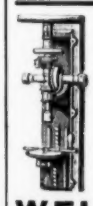

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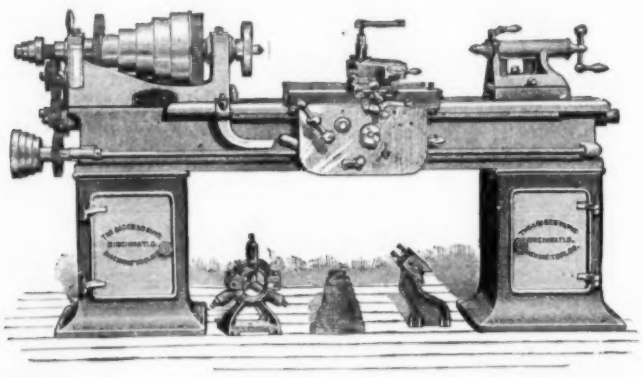

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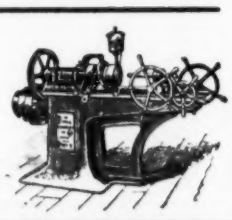

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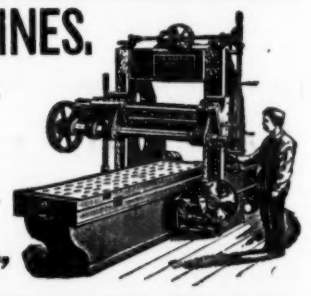

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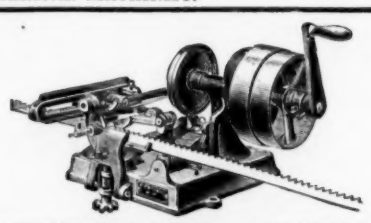

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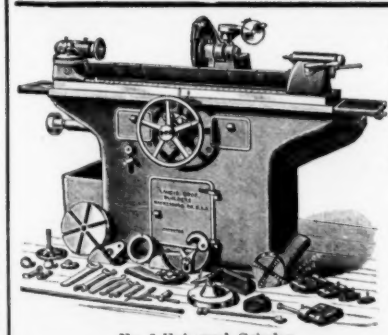

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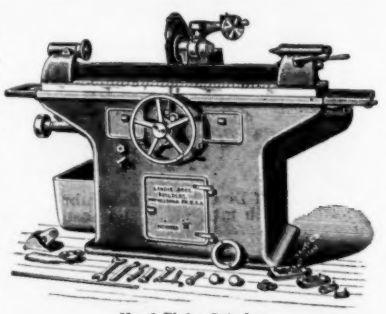

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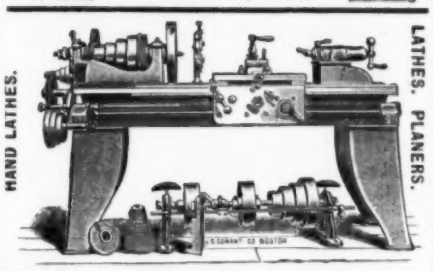

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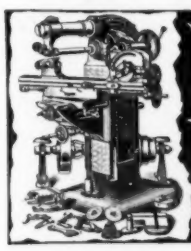

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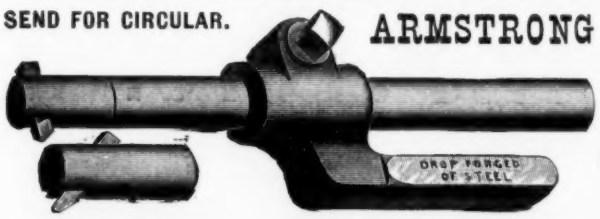

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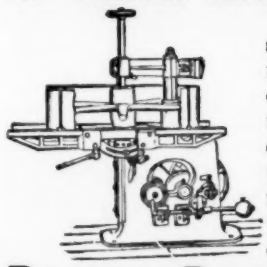

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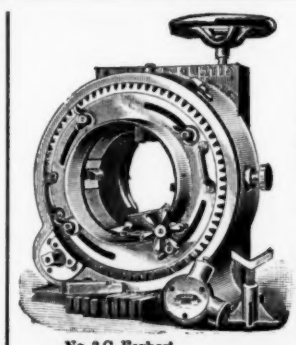

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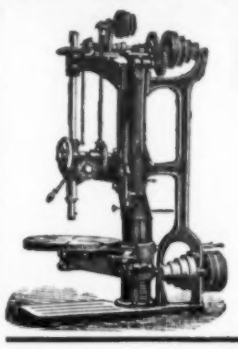

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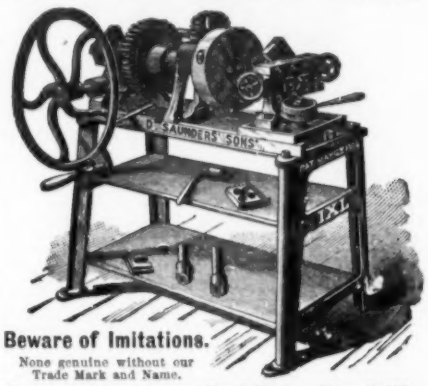

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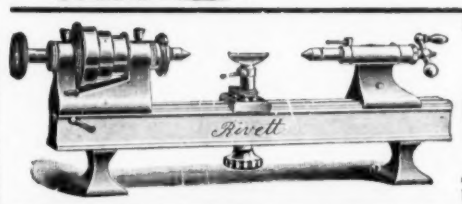

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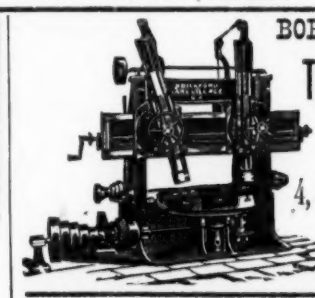

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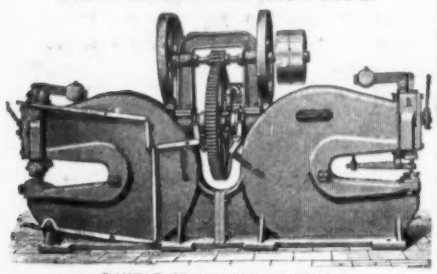

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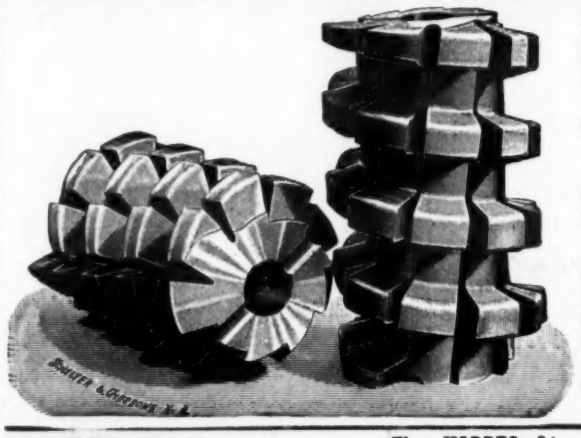

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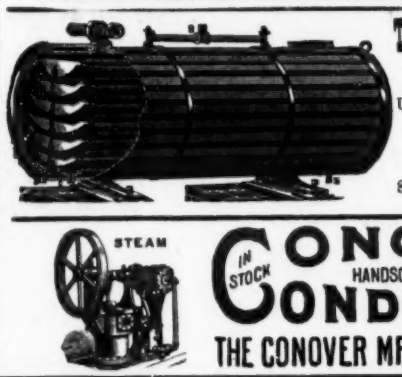

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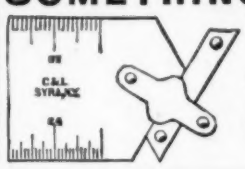

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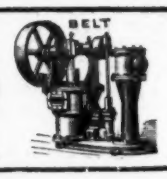

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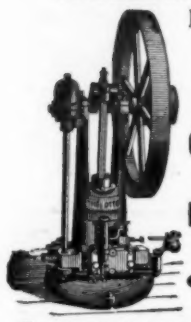

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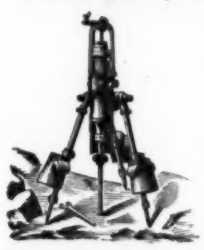

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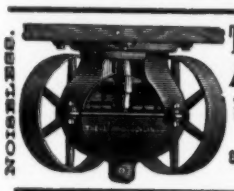

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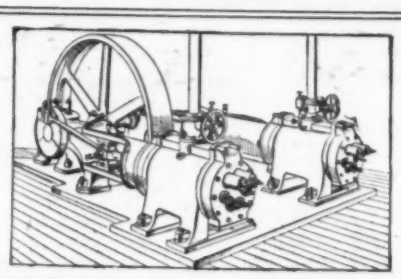

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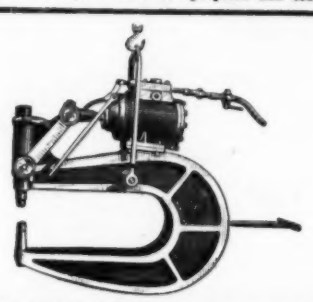

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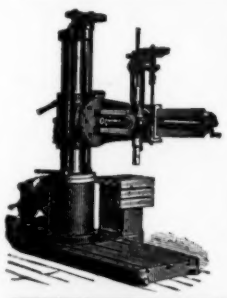

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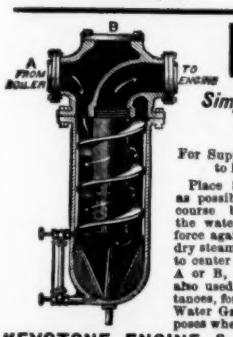

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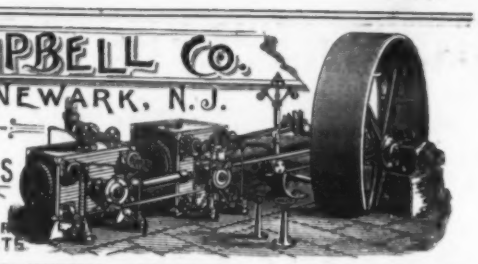

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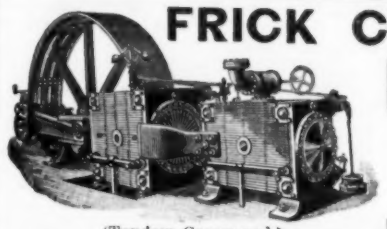

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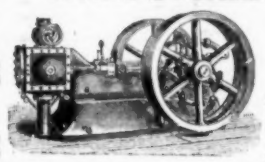

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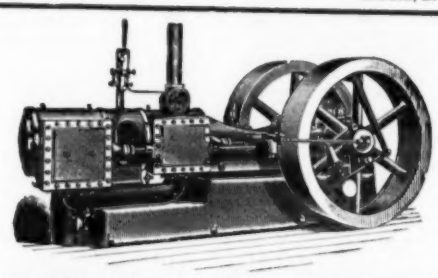

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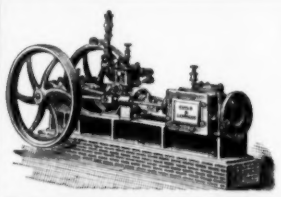

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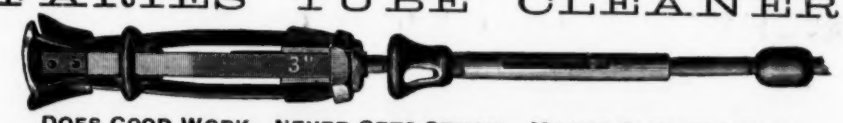

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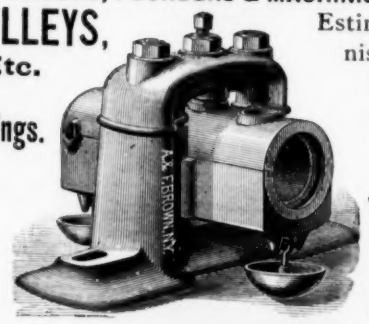

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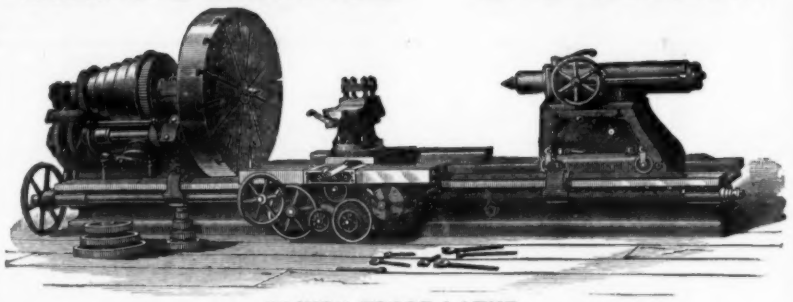

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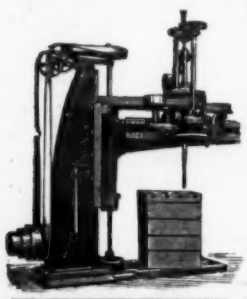

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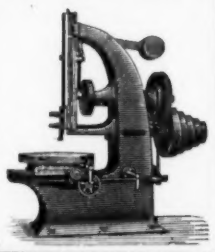

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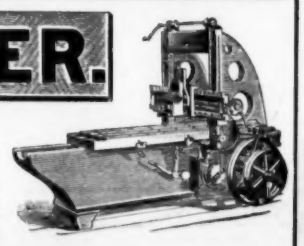

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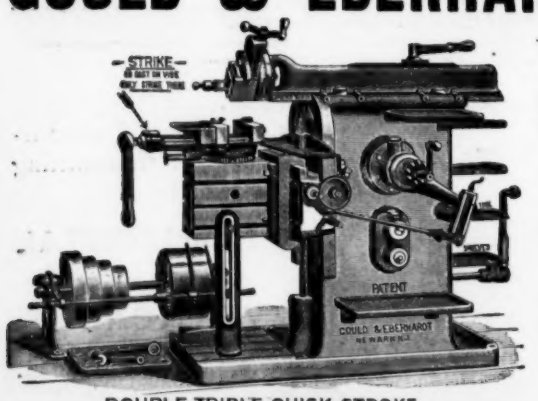

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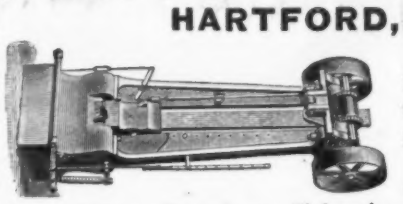

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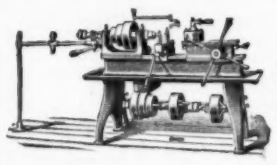

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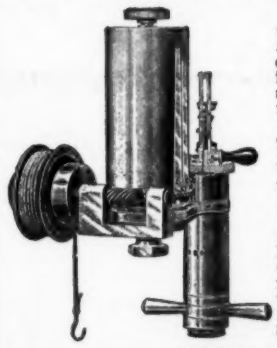

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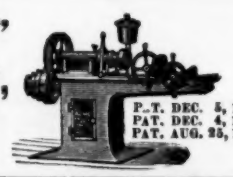

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